MANHATTAN CONTAINER FACILITY FEASIBILITY STUDY

Prepared for

The City of New York
Economic Development Administration
Department of Ports and Terminals

by

HARBRIDGE HOUSE, INC.

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ROBERT BRANDWEIN
Vice President

March 1, 1971

Commissioner Patrick F. Crossman
Department of Ports and Terminals
Battery Maritime Building
New York, New York 10004

Dear Commissioner Crossman:

Harbridge House, Inc., is pleased to enclose a final copy of the Manhattan Container Facility Feasibility Study, performed under contract number 3444.

If you have any questions or comments, please contact us.

Sincerely yours,

Robert Brandwein

RB:sc

INTRODUCTION

This research report is designed to determine the economic feasibility of locating a container facility on Manhattan.

In meeting this objective, the research effort was structured to examine as realistically and comprehensively as possible the market demands, economic factors and costs/benefits of the proposed Manhattan Container Facility (MCF). However, time and level of effort considerations were limiting factors in developing primary data on origins/destinations of containerable cargo for Manhattan. Therefore, it should be understood that the estimates of potential demand for a MCF--developed in Chapter IV--are subject to some uncertainty.

The proposed MCF is analyzed in the first five chapters.

- I Survey of Potential Sites
- II Alternative Container Terminal Systems
- III Cost Analysis of Alternative Container Facilities
- IV Estimated Demand for a Manhattan Container Facility
- V Costs and Benefits

Chapter VI presents a summary of the conclusions of the research effort.

Chapter I

SURVEY OF POTENTIAL SITES

Introduction

The first phase of the Manhattan Container Facility Feasibility Study was a survey of potential sites in order to identify, examine and evaluate sites on the Manhattan waterfront that would best satisfy the generally accepted requirements for a container facility. This chapter is organized into three sections, corresponding to the major tasks comprising the survey effort.

- Identification of key site requirements and characteristics.
- Selection and description of sites to be surveyed.
- Evaluation of potential sites.

Identification of Key Site Requirements

In order to establish criteria for intensive study of a limited number of potential sites on the Manhattan waterfront and to establish consistent specifications for describing and later evaluating these sites, it was necessary to identify the key factors which come into play in locating a container facility. The site requirements for a container facility depend, of course, upon the specific nature of the facility to be developed. Many factors in the design and operation of a facility--such as the targeted throughput capacity, the number of berths, the roles

of rail and truck transport, the storage technology utilized, and the type of cargo control and retrieval system employed--will define and require specific site characteristics. For example, the land area required per berth for conventional horizontal container storage systems ranges between 25 and 35 acres, while the adoption of a vertical storage system or horizontal travel crane system reduces the land area requirement per berth to 15-20 acres.

Because the nature of a projected facility determines the site requirements to such a great extent, as a starting point we postulated the type and scale of container facility that might be situated on the Manhattan waterfront--a container facility of conventional design and modest scale, with the following general characteristics.

- Two to five marginal berths, each a minimum of 850 linear feet.[1/]
- Annual throughput cargo capacity per berth of 500,000 to 1,500,000 tons.
- Minimum cargo storage and marshalling area of 25 acres per berth.[2/]
- Rapid accessibility by truck transport.
- Extensive off-street truck queueing area.
- Provision for stuffing and stripping sheds and related facilities (customs, administrative, utilities, lavatories, employee parking).

1/ It was decided that a new container facility would need at least two berths in order to serve at least two ships at the same time so as to be competitive with existing facilities.

2/ Although a vertical facility does not require as much land, it was decided to first compare cost data for each system on the same location.

Existing container operations (such as Port Newark, Port Elizabeth and Seattle) were examined in order to identify key site requirements and characteristics. This examination included: on-site observation; interviews with key engineering, operations and administrative personnel; and reviews of primary and secondary sources on container facility design and operation. The key factors identified were:

- Site area and configuration: Site area potentially available for facility usage must be at least 60 acres. Site configuration must be appropriate to permit berthing of at least two vessels and to allow utilization of the entire site area.
- Geological characteristics: Depth of bedrock must be reasonably consistent and sufficiently shallow to permit land fill and/or pile driving at reasonable cost.
- Land use, structures and facilities: Use of land contiguous to the site must be compatible with proposed transportation usage. Structures and facilities on the site must be susceptible to demolition at reasonable cost or, if of substantial economic value, situated in such a manner as not to compromise facility design and operation.

Selection of Sites

A substantial number of sites along the Manhattan waterfront which are accessible to seagoing vessels appear to have some potential for the development of container-handling facilities. However, given the location constraints identified above, only a few sites showed sufficient promise to merit intensive analysis.

The entire East River waterfront was excluded from consideration because it fails to meet the requirements for land area. More specifically, there are no large tracts of upland fronting on the bulkhead that are not either in economic land use at present or slated for redevelopment to other uses. Furthermore, the distance between the bulkhead and the pierhead is too short and the bedrock falls away too sharply to permit an acceptable configuration of development and land area. It should be noted, however, that changing container facility technology might require reconsideration of a possible East River site at a later date.

As to the North River, while the distance from bulkhead to pierhead is suitable for container facility operations, in many instances, the filled offshore area is not large enough for an entire marine container terminal. Moreover, it is highly desirable that contiguous upland areas be potentially available, particularly for the horizontal container systems. Along the North River waterfront there are only four tracts of upland which meet this requirement. These tracts, together with their respective stretches of contiguous offshore areas (representing potential sites) may be grouped as follows:

- General Area I: North of West 59th Street

  --Upland Area A, the uptown Penn Central Yards
  --Offshore Area 1, West 72nd Street to Pier 99

- General Area II: The West 30's Area

  --Upland Area B, the midtown Penn Central Yards
  --Offshore Area 2, Pier 76 to West 30th Street
  --Offshore Area 3, West 30th Street to Pier 63

- General Area III: The Chelsea-Gansevoort Market Area

  --Upland Area C, the Gansevoort Market Area
  --Offshore Area 4, Pier 63 to Pier 52
  --Offshore Area 5, Pier 52 to Pier 42

- General Area IV: The Washington Street Renewal Project Area

  --Upland Area D, the Washington Street Renewal Project
  --Offshore Area 6, Charlton Street to Pier 21
  --Offshore Area 7, Pier 21 to the Battery

The description of the four general areas identified above is divided into two parts: (1) geographic factors; and (2) cost of site acquisition and preparation.

Geographic Factors

To permit maximum flexibility of description and comparison, each general area was broken down into its constituent components--an upland area and one or more offshore areas.

Typically, each upland area consists of two geographical parts which differ in ownership and usage and, consequently, in availability. Each upland area is further broken down and described by sector: the marginal sector, which includes the westernmost strip of the upland area bounded on the west by the Bulkhead Line and on the east by the eastern line of the marginal street; and the inland sector, which includes all the remaining portions of the upland area.

Each offshore area is associated with the upland area to which it is contiguous or most proximate. For convenience and flexibility of description and comparison, the entire Manhattan North River waterfront--excluding those sections with recently-constructed piers or where access is impaired by other uses--is classified into seven offshore areas. In general, each of these areas is defined as being bounded on the east by the Bulkhead Line and on the west by a line one hundred feet inshore of the U.S. Pierhead Line. The upstream and downstream boundaries of each offshore area were selected in order to delineate a strip of waterfront

with generally homogeneous present usage and housing structures of generally consistent physical condition. Acreage and frontage data for each of the four general areas are presented in Exhibit 1.

General Area I: North of West 59th Street. General Area I, totaling 106 acres, consists of Upland Area A and Offshore Area 1. The relationships and configurations of the Area I components are illustrated in Figure 1.

a. Upland Area A

Upland Area A, estimated at 65 acres, is irregular in configuration, and is bounded on the north by the southerly line of West 72nd Street, on the east by the Lincoln Center Apartments and western side of West End Avenue, on the south by the northern side of West 59th Street, and the west by the U.S. Bulkhead Line.

Upland Area A has approximately 3,300 feet of frontage along the Bulkhead Line. Site width inshore of the Bulkhead Line increases from 500 feet at the upstream end to 1,100 feet at the downstream end. The marginal sector, consisting of 23 acres, is virtually rectangular in configuration. It averages 300 feet in width (inshore of the U.S. Bulkhead Line) and extends the length (3,300 feet) of the frontage of Upland Area A upon the bulkhead. The inland sector, estimated at 42 acres, increases in width from 200 feet at the upstream end to 800 feet at the downstream end, and runs the entire length (3,300 feet) of the site.

Subsoil conditions are generally consistent along the length of Upland Area A. Along the eastern boundary of the site, depth (measured against mean low water) of bedrock varied from 0 feet to -30 feet. Moving

Exhibit 1

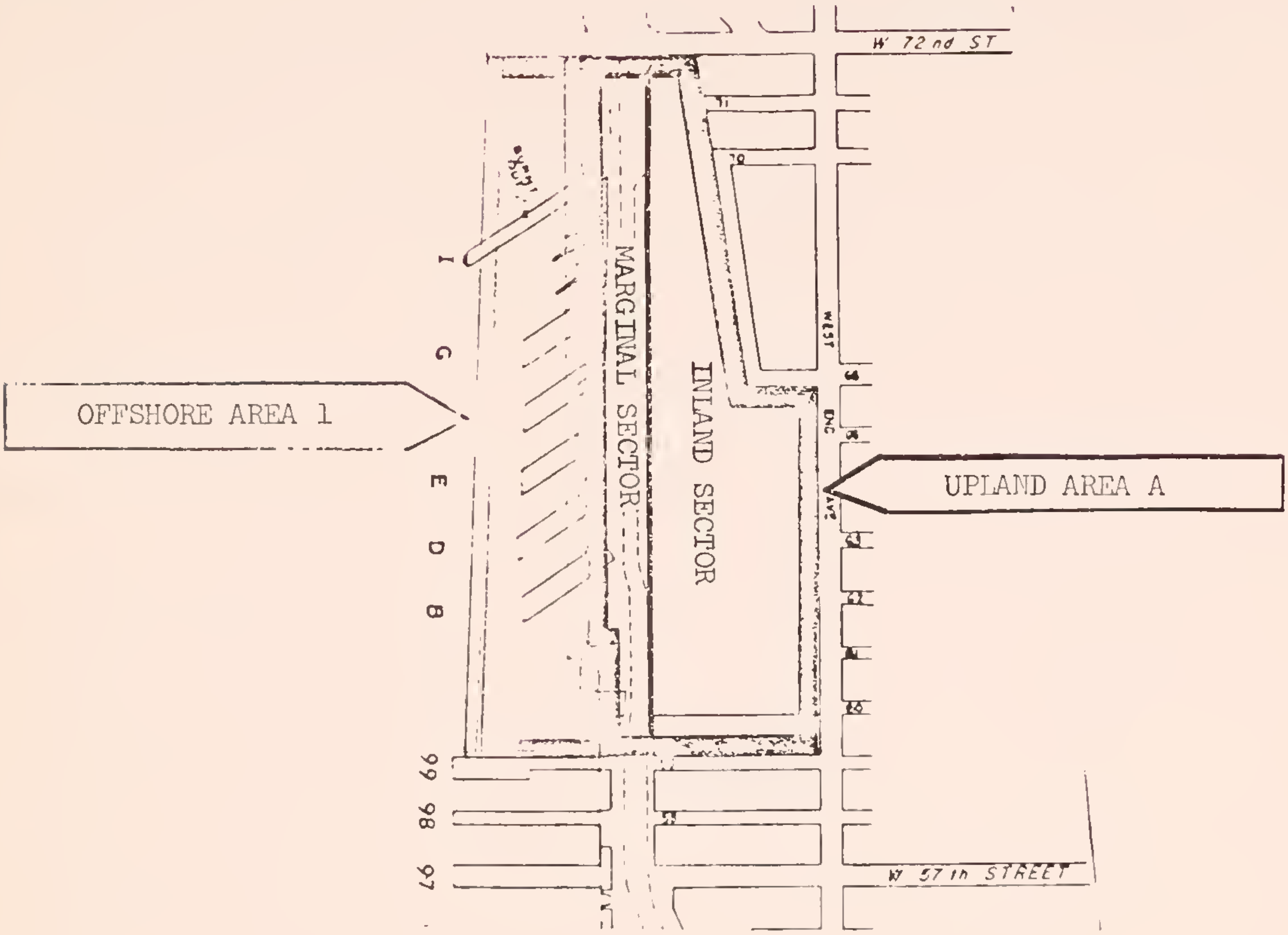
SUMMARY DATA FOR SELECTED AREAS

	Acreage	Frontage (ft.)
General Area I: North of West 59th St.		
Upland Area A:		
Total Area	65	3,300
Marginal Sector	23	3,300
Inland Sector	42	3,300
Offshore Area 1	41	3,320
General Area II: The West 30's Area		
Upland Area B:		
Total Area	57	2,250
Marginal Sector	13	2,250
Inland Sector	44	2,250
Offshore Area 2	26	1,900
Offshore Area 3	19	1,850
General Area III: The Chelsea-Gansevoort Market Area		
Upland Area C:		
Total Area	64	2,750
Marginal Sector	16	2,750
Inland Sector	48	2,750
Offshore Area 4	66	4,500
Offshore Area 5	48	2,900
General Area IV: The Washington St. Renewal Project Area		
Upland Area D:		
Total Area	40	2,500
Marginal Sector	14	2,500
Inland Sector	26	2,500
Offshore Area 6	74	3,520
Offshore Area 7	75	5,200

Source: Derived from field observation, interviews, review of public agency records and surveys, and other primary and secondary sources.

Figure 1

GENERAL AREA I: NORTH OF WEST 59TH STREET



west across the site to the bulkhead, the depth of bedrock increases sharply. At the U.S. Bulkhead Line, the depth of bedrock varies from -60 feet to -90 feet.

Most of the land included in Upland Area A is owned by the Penn Central. Various private owners hold title to air rights or land for commercial facilities in the area. Mention has been made of city negotiations to purchase all or part of the land, but nothing seems to have come of this. Pan American Airways, however, holds an option to purchase some or all of the property included in Upland Area A and has proposed the development of a STOL port.

The predominant land use of Upland Area A is rail car standing, switching and loading. This utilizes much of the entire inland sector of the site. Facilities and structures presently on the inland sector include: freight consolidation; trucking terminals; warehousing; rail trackage, switching and control mechanisms; and loading platforms.

Land use of the marginal sector is more varied and includes: marshalling and storage of cargo and empty rail cars, trailers and containers; parking of yard machinery and chassis; and rail trackage and switching equipment connecting the yards of the inland sector with Piers B through I; and the lighterage transfer bridges, all of which are owned by the Penn Central. Passing over the marginal sector is the West Side Elevated Highway. (Clearance under the highway reaches a maximum of about 100 feet in the northern sector of the area. It is then maintained at 80 feet for several blocks before decreasing to about 20 feet at the southern portion of the area.) With the exception of Penn Central

railroad facilities, the connecting trackage and the elevated highway, no permanent structures or facilities are located on the marginal sector.

Land usage of properties contiguous to Upland Area A are varied. The property adjacent to the northern boundary of the site is owned by the city and is given over to waterfront parks and recreation and to the Henry Hudson Parkway. Contiguous land on the east includes residential (Lincoln Center Apartments), office and mixed residential and commercial usages; the Housing and Development Administration is taking some of this land for urban renewal. Land usage contiguous to the south of the site is mixed commercially and industrially.

Straddling the Penn Central freight lines that penetrate Manhattan, Upland Area A has direct access--via Poughkeepsie--to New England, Canada, the Midwest, the West, the Mid-Atlantic States and the South.

Truck access to and from Upland Area A involves the extensive use of local streets. Proximity and simplicity of access to and from the major points of over-the-road entry and egress from Manhattan vary. In order of increasing difficulty of truck access to and from Upland Area A are: the Lincoln Tunnel; the Holland Tunnel; the Queens Mid-Town Tunnel; the Brooklyn Battery Tunnel; and the Williamsburg, Manhattan and Brooklyn Bridges.

b. Offshore Area 1

Offshore Area 1, totaling 41 acres, is bounded upstream by an extension of the south side of West 72nd Street and downstream by the north side of Pier 99. The width of the area varies from 570 feet upstream to 700 feet downstream, with a length of 3,320 feet parallel to the U.S. Pierhead Line.

The entire offshore area is owned by the Penn Central; however, Pan American Airways currently holds an option on the property to develop a STOL port. Six piers, all in poor to very poor condition, are located in the area; of these, Piers B, D, E and I are not used, while Piers F and G are utilized for railroad freight. Other facilities, all in fair condition, are transfer bridges used for railroad freight, and a bulkhead platform, not in use. Except for Pier F, utility services are either nonexistent or not in working order.

The depth of water along the Pierhead Line varies from 30 feet to 36 feet, while the depth of bedrock ranges from -80 feet to -180 feet. The thickness of the Hudson River silt strata varies from 25 feet to 160 feet. While the area can be filled, a staged construction program over a four-year period would be required.

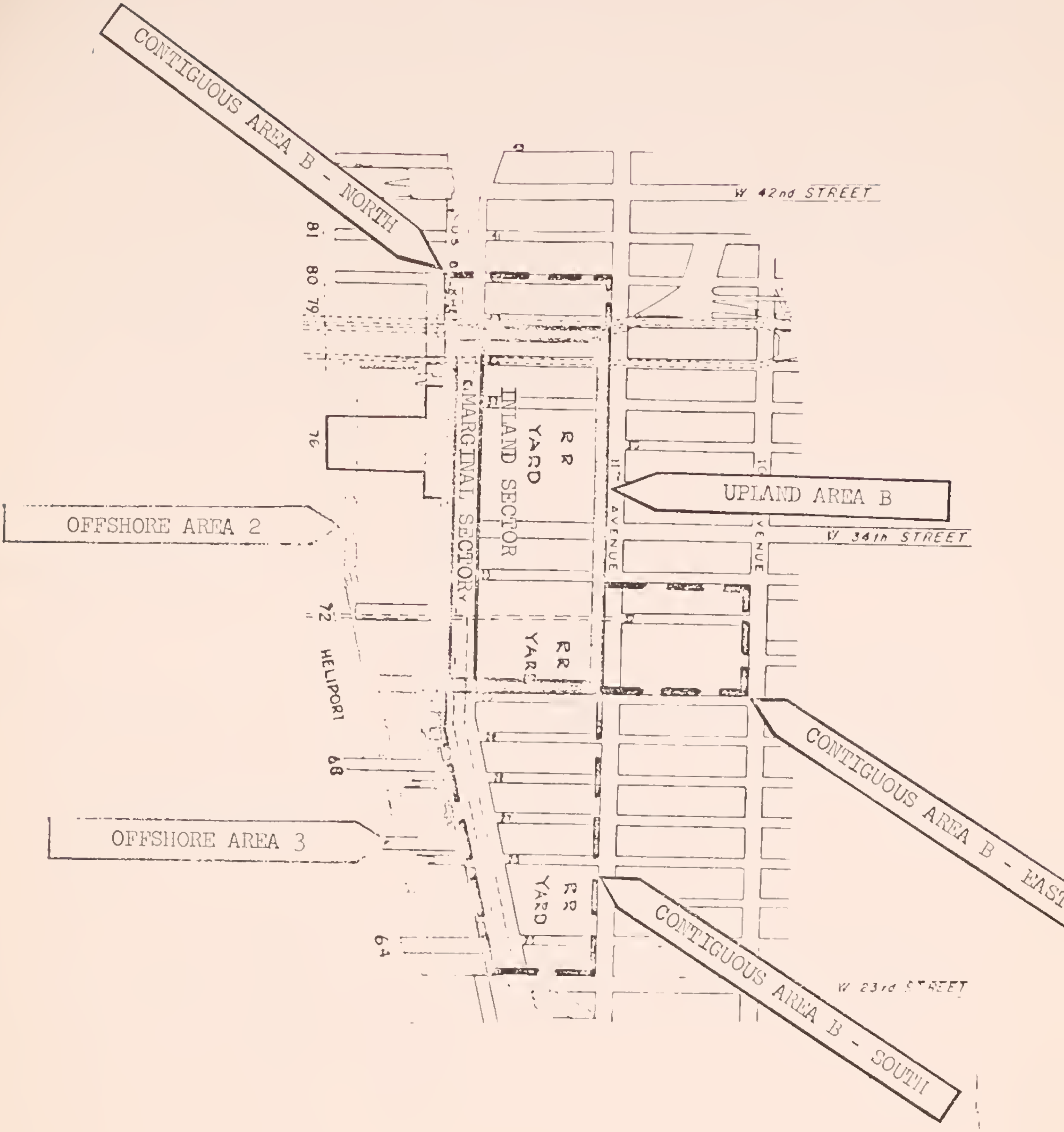
General Area II: The West 30's Area. General Area II, totaling 102 acres, consists of Upland Area B, Offshore Area 2 and Offshore Area 3. The relationships and configurations of the Area II components are illustrated in Figure 2. Three properties contiguous to Upland Area B, noted as Contiguous Areas B-North, B-East and B-South, may be suitable for expansion.

a. Upland Area B

Upland Area B, estimated at 57 acres, is rectangular in configuration. The area is bounded on the north by the southern side of West 39th Street, on the east by the western side of Eleventh Avenue, on the south by the northern side of West 30th Street, and on the west by the U.S. Bulkhead Line.

Figure 2

GENERAL AREA II: THE WEST 30'S AREA



Upland Area B has approximately 2,250 feet of frontage along the Bulkhead Line. Site width inshore of the Bulkhead Line is 1,100 feet. The marginal sector, consisting of 13 acres, is rectangular in configuration. It is 250 feet wide (inshore of the Bulkhead Line) and extends the length (2,250 feet) of the frontage of Upland Area B upon the bulkhead. The inland sector, estimated at 44 acres, is 850 feet wide and runs the entire length (2,250 feet) of the site.

Subsoil conditions are generally consistent along the length of Upland Area B. Along the eastern boundary of the site, depth (measured against mean low water) of bedrock varies from +10 feet to -20 feet. Moving west across the site to the bulkhead, the depth of bedrock increases sharply. At the Bulkhead Line, the depth of bedrock varies from -80 feet to -140 feet.

The ownership of Upland Area B is divided: the marginal sector is owned by the City of New York; and most of the inland sector is owned by the Penn Central.

The predominant land use of the inland sector is for rail car standing, switching and loading. Facilities and structures presently on the inland sector of the site include: trucking terminals; warehousing; rail trackage, switching and control mechanisms; and loading and platform sheds.

The marginal sector exhibits more varied land uses--those conventionally associated with waterfront activities. These include:

- Through and local traffic on the marginal way and Twelfth Avenue.

- Access to facilities offshore of the Bulkhead Line.

  --Heliport (Port of New York Authority)
  --Pier 76 (U.S. Lines)
  --Pier 78 (Penn Central transfer bridges)
  --Lincoln Tunnel ventilator towers

- Access to warehousing facilities situated on the western boundary of the inland sector.
- The West Side Elevated Highway (about 20-foot clearance in this area).
- The storage of cargo and trailers.
- Ready-mix concrete plant and storage bins.
- Employee parking facilities.

With the exception of the elevated highway and the Lincoln Tunnel ventilator towers, no permanent structures are situated within the marginal sector. (The structures related to the concrete activities are not considered to be of a permanent nature.)

Land usage of properties contiguous to Upland Area B are varied. Pieces of the property adjacent to the northern boundary of the site (Contiguous Area B-North), which have several owners, have mixed commercial (largely warehousing and trucking terminals) usage and railroad rights of way. Contiguous properties along the northern two-thirds of the eastern boundary of Upland Area B are similarly utilized. Property adjacent to the southern third of the eastern boundary (Contiguous Area B-East) is owned by the Penn Central and is devoted mostly to typical rail yard usage. Property adjacent to the southern boundary of Upland Area B (Contiguous Area B-South) is devoted to mixed commercial, industrial and rail usage.

Straddling the Penn Central freight lines that penetrate Manhattan, Upland Area B has direct access--via Poughkeepsie--to New England, Canada, the Midwest, the West, the Mid-Atlantic States and the South.

Truck access to and from Upland Area B involves the extensive use of local streets. Proximity and simplicity of access to and from the major points of over-the-road entry and egress from Manhattan vary. In order of increasing difficulty of truck access to and from Upland Area B are: the Lincoln Tunnel; the Holland Tunnel; the Queens Mid-Town Tunnel; the Brooklyn Battery Tunnel; and the Williamsburg, Manhattan and Brooklyn Bridges.

b. Offshore Area 2

Offshore Area 2, totaling 26 acres, is bounded upstream by the north side of Pier 76 and downstream by an extension of the north side of West 30th Street. The width of the area varies from 750 feet upstream to 570 feet downstream, with a length of 1,900 feet parallel to the Pierhead Line.

The entire offshore area is owned by the City of New York. The Port Authority uses the 30th Street Heliport, a portion of which is in Offshore Area 2. Piers 72 and 76 are also located in the area. Pier 76, used by U.S. Lines, is in very good condition; however, this pier is not able to handle fully containerized ships. Pier 72 is vacant, and is in very poor condition. Utilities are also in very poor condition, with the exception of Pier 76.

The depth of water along the Pierhead Line varies from 20 feet to 30 feet, while the depth of bedrock ranges from -90 feet to -240

feet. The fill potential is fair because of the thickness of the Hudson River silt strata which varies from 60 feet to 210 feet.

c. Offshore Area 3

Offshore Area 3, totaling 19 acres, is bounded upstream by the north side of West 30th Street and downstream by the north side of Pier 63. The width of the area varies from 550 feet upstream to 520 feet downstream, with a length of 1,850 feet parallel to the Pierhead Line.

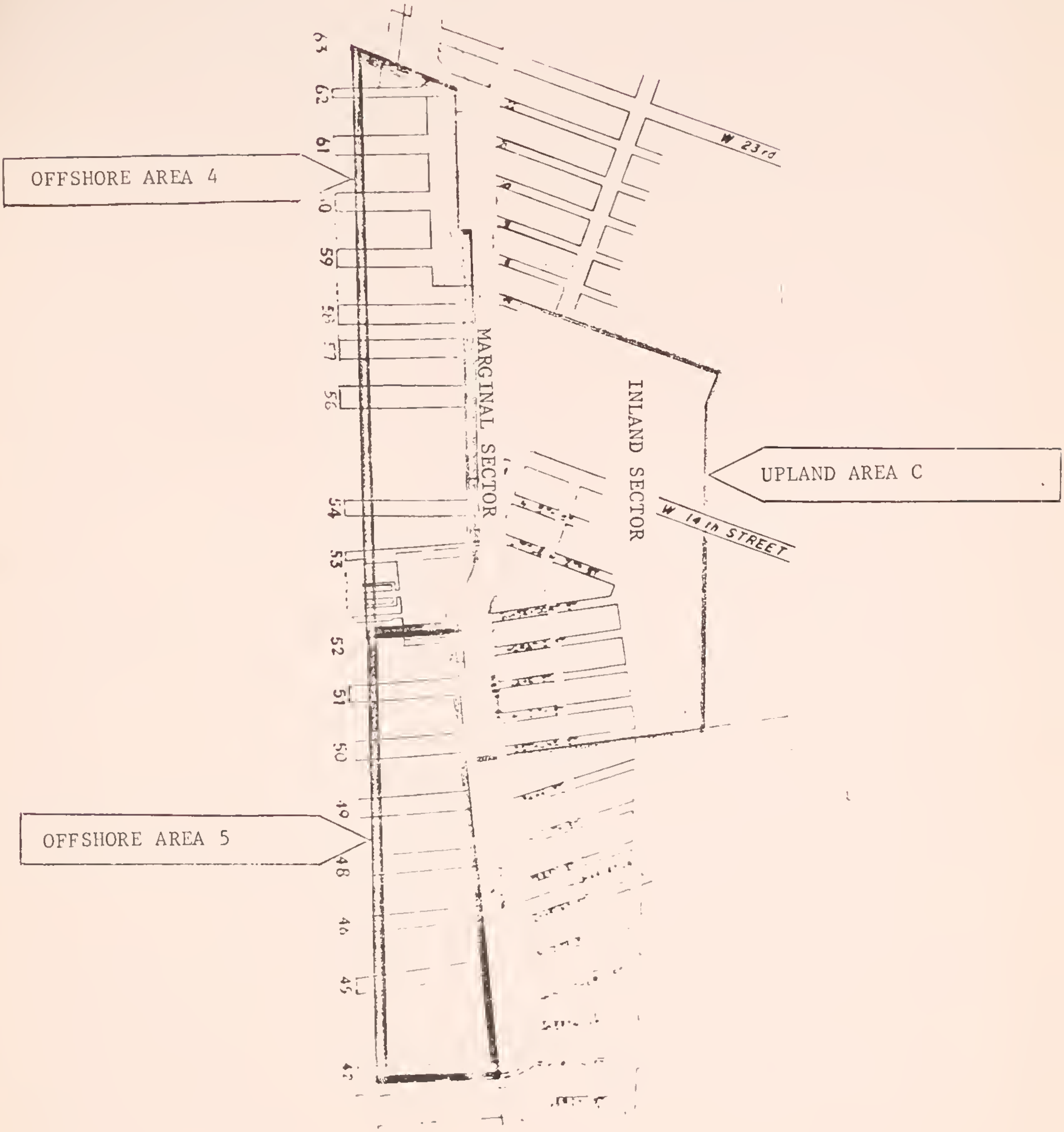
The Lehigh Valley Railroad Company owns the rail transfer bridge between Piers 64 and 66; the Erie Lackawanna Railroad Company owns the rail transfer bridge between Piers 66 and 68; and the City of New York owns the rest of the area. A portion of the 30th Street Heliport is also in Offshore Area 3. Facilities include Piers 66 and 68, both vacant and in poor condition, as well as Pier 64, which is in good condition and is used for general cargo and passengers. The two railroad transfer bridges in the area are in use and in good condition. Utilities in the area range from poor to good condition.

The depth of water along the Pierhead Line varies from 25 feet to 35 feet, while the depth of bedrock ranges from -140 feet to -210 feet. The fill potential is unknown but is assumed to be poor because of the thickness of the Hudson River silt strata which varies from 100 feet to 200 feet.

General Area III: The Chelsea-Gansevoort Market Area. General Area III, totaling 178 acres, consists of Upland Area C, Offshore Area 4 and Offshore Area 5. (See Figure 3.)

Figure 3

GENERAL AREA III:
THE CHELSEA-GANSEVOORT MARKET AREA



a. Upland Area C

Upland Area C, totaling 64 acres, is irregular in configuration. The area is bounded on the north by the south side of West 17th Street, on the east by the west side of Hudson Street which turns into Ninth Avenue, on the south by the north side of Bethune Street, and on the west by the U.S. Bulkhead Line.

Upland Area C has approximately 2,750 feet of frontage along the Bulkhead Line. Site width inshore of the Bulkhead Line varies from 1,000 feet to 1,450 feet. The marginal sector, consisting of 16 acres, is irregular in configuration. It is 250 feet wide (inshore of the Bulkhead Line) and extends the length (2,750 feet) of the frontage of Upland Area C upon the bulkhead. The inland sector, estimated at 48 acres, varies in width from 750 feet to 1,200 feet and runs the entire length (2,750 feet) of the site.

Subsoil conditions are generally consistent along the length of Upland Area C. Along the eastern boundary of the site, depth (measured against mean low water) of bedrock varies from -40 feet to -50 feet. At the Bulkhead Line, depth of bedrock varies from -80 feet to -120 feet.

The ownership of Upland Area C is divided: the marginal sector is owned by the City of New York; mixed private ownership characterizes the inland sector.

A major land use of the inland sector is for a meat market and related commercial activities. Facilities and structures presently on the inland sector of the site include: trucking terminals; warehousing; rail trackage, switching and control mechanisms; and loading platforms and sheds. Residential apartments and various commercial business structures also exist in the area.

The marginal sector exhibits more diverse land uses--those conventionally associated with waterfront activities. These include:

- Through and local traffic on the marginal way and Eleventh Avenue.
- Access to facilities offshore of the Bulkhead Line.

  --Incinerator and disposal plant
  --Piers 59 through 62 (U.S. Lines)
  --Other piers and miscellaneous usages

- Access to meat market facilities.
- The West Side Elevated Highway (about 20-foot clearance in this area).
- The storage of cargo and trailers.
- Employee parking facilities.

With the exception of the elevated highway and the incinerator and disposal plant, no permanent structures are situated within the marginal sector.

Land usage of properties contiguous to Upland Area C are varied. Pieces of the property adjacent to the northern boundary of the site, which have several owners, have mixed commercial usage and railroad rights of way. Properties adjacent to the eastern and southern boundaries of Upland Area C have mixed residential, commercial and industrial usage.

At the southern terminal of the Penn Central rail viaduct, Upland Area C has direct access--via Poughkeepsie--to New England, Canada, the Midwest, the West, the Mid-Atlantic States and the South.

Truck access to and from Upland Area C involves the extensive use of local streets. Proximity and simplicity of access to and from the major points of over-the-road entry and egress from Manhattan vary. In

order of increasing difficulty of truck access to and from Upland Area C are: the Holland Tunnel; the Lincoln Tunnel; the Brooklyn Battery Tunnel; the Williamsburg, Manhattan and Brooklyn Bridges; and the Queens Mid-Town Tunnel.

b. Offshore Area 4

Offshore Area 4, totaling 66 acres, is bounded upstream by the north side of Pier 63 and downstream by the north side of Pier 52. The width of the area varies from 520 to 870 feet in the upstream region and from 700 to 870 feet in the downstream region, with a length of 4,500 feet parallel to the Pierhead Line.

The entire area is owned by the City of New York. The Department of Purchase uses Pier 54 and the Department of Ports and Terminals uses Piers 56 and 58; all three of these piers are in fair to good condition. Piers 59 through 62, all in very good condition, are utilized by U.S. Lines. Pier 57, in very good condition, is vacant. Pier 63, also in very good condition, is being used by a moving and storage company. Truck parking exists on Pier 53, which is in very poor condition. The area also includes an incinerator and disposal plant, both of which are in very good condition. Utilities in the area vary from very poor to good condition.

The depth of water along the Pierhead Line varies from 30 feet to 45 feet, while the depth of bedrock ranges from -90 feet to -380 feet. The fill potential is poor, partially because of the thickness of the Hudson River silt strata which varies from 20 feet to 200 feet.

c. Offshore Area 5

Offshore Area 5, totaling 48 acres, is bounded upstream by the north side of Pier 52 and downstream by the south side of Pier 42. The width of the area varies from 700 feet upstream to 950 feet downstream, with a length of 2,900 feet parallel to the Pierhead Line.

The City of New York owns the entire area. The Board of Education uses Pier 42, and the Police Department uses Pier 49; both of these piers are in fair to poor condition. Piers 46, 48, 50, 51 and 52--all in poor to good condition--are used for rail freight. Pier 45 is vacant, but in good condition. Utilities in the area vary from poor to good condition.

The depth of water along the Pierhead Line varies from 30 feet to 38 feet, while the depth of bedrock varies from -90 feet to -160 feet. The thickness of the Hudson River silt strata varies from 25 feet to 90 feet. The fill potential is good; however, a construction period of at least three years is necessary.

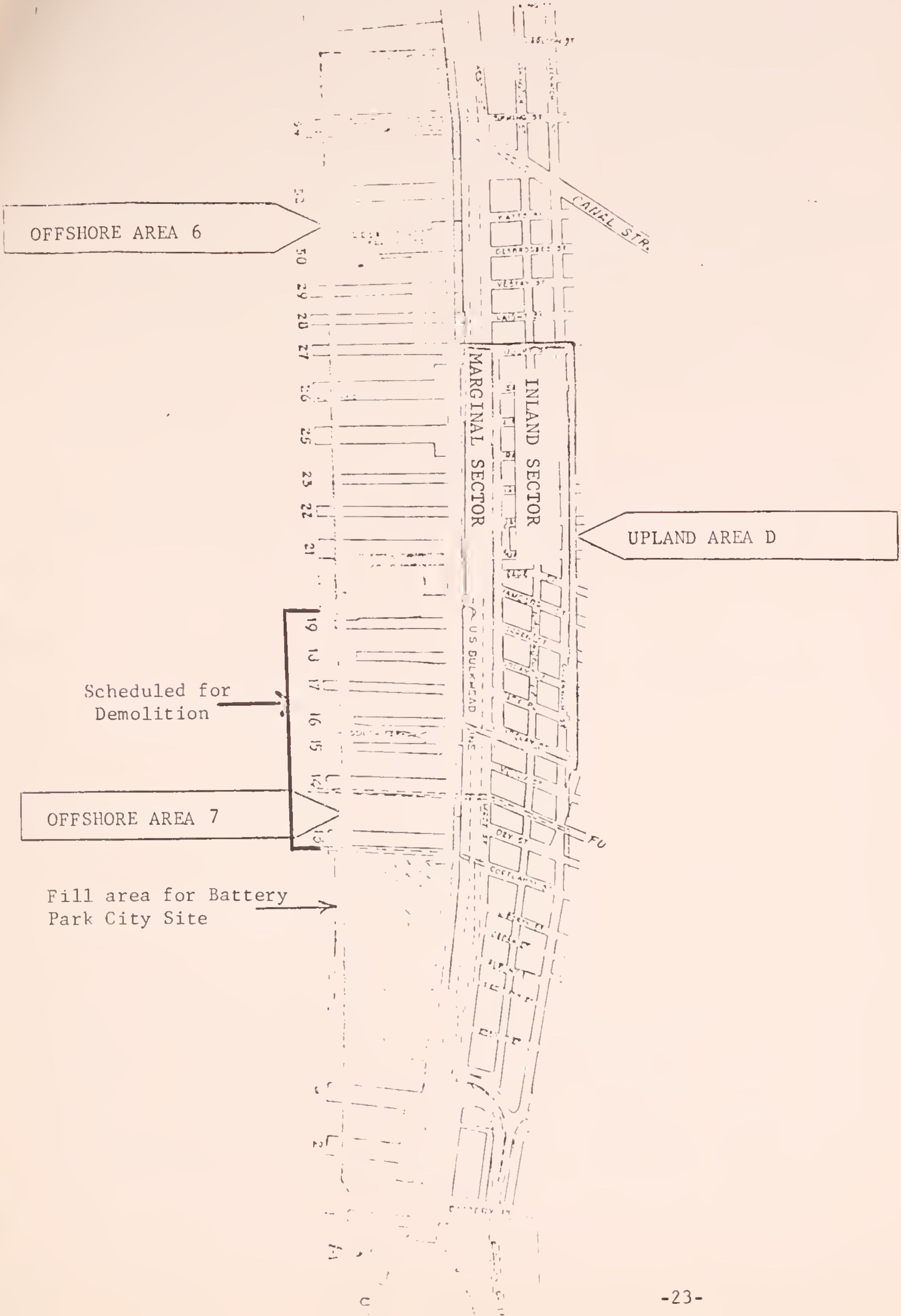
General Area IV: The Washington Street Renewal Project Area. General Area IV, totaling 189 acres, consists of Upland Area D, Offshore Area 6 and Offshore Area 7. (See Figure 4.)

a. Upland Area D

Upland Area D, totaling 40 acres, is rhomboidal in configuration. The area is bounded on the north by the south side of Hubert Street, on the east by the west side of Greenwich Street, on the south by the north side of Barclay Street, and on the west by the U.S. Bulkhead Line.

Upland Area D has approximately 2,500 feet of frontage along the Bulkhead Line. Site width inshore of the Bulkhead Line is about 600

GENERAL AREA IV:
THE WASHINGTON STREET RENEWAL PROJECT AREA



feet. The marginal sector, consisting of 14 acres, is rectangular in configuration. It is 250 feet wide and extends the length (2,500 feet) of the frontage of Upland Area D upon the bulkhead. The inland sector, estimated at 26 acres, is 350 feet wide and runs the entire length of the site.

Subsoil conditions are generally consistent along the length of Upland Area D. The depth (measured against mean low water) of bedrock varies in an irregular pattern between -100 feet and -70 feet.

The marginal sector of Upland Area D is owned by the City of New York, and the inland sector is controlled by the Housing and Development Administration.

The marginal sector exhibits more diverse land uses--those conventionally associated with waterfront activities. These include:

- Through and local traffic on the marginal way and West Street.
- The West Side Elevated Highway (about 20-foot clearance in this area).
- The storage of cargo and trailers.
- Employee parking facilities.

With the exception of the elevated highway, no permanent structures are situated within the marginal sector.

The inland sector has varied commercial usage, such as coffee and spice plants, trucking terminals and warehouses. However, part of the area has already been demolished, and some buildings are partially or totally vacant. The contiguous areas on the north, south and east are largely made up of commercial activities. The contiguous area to the south includes part of the new trade center presently being built.

There is no rail access to Upland Area D. Truck access to and from the area involves the extensive use of local streets. Proximity and simplicity of access to and from the major points of over-the-road entry and egress to and from Upland Area D are: the Brooklyn Battery Tunnel; the Holland Tunnel; the Williamsburg, Manhattan and Brooklyn Bridges; the Lincoln Tunnel; and the Queens Mid-Town Tunnel.

b. <u>Offshore Area 6</u>

Offshore Area 6, totaling 74 acres, is bounded upstream on the south side by an extension of Charlton Street and downstream by the south side of Pier 21. The width of the area ranges from 1,050 feet upstream to 970 feet downstream, with a length of 3,520 feet parallel to the Pierhead Line.

The entire area is owned by the City of New York. The Police Department uses Piers 25 and 34, both in good condition. Piers 27 through 29, all in poor condition, are utilized as produce terminals. Piers 22 and 23, both in good condition, are vacant. Piers 21 and 32, also in good condition, are used, respectively, for rail freight and cargo. Pier 26, in very poor condition, is used for truck parking and market activities. Utilities in the area vary from poor to very good condition.

The depth of water along the Pierhead Line varies from 25 feet to 40 feet, while the depth of bedrock ranges from -60 feet to -100 feet. The thickness of the Hudson River silt strata varies from 0 feet to 40 feet. The fill potential for this area is good.

c. <u>Offshore Area 7</u>

Offshore Area 7, totaling 75 acres, is bounded upstream by the south side of Pier 21 and downstream by the intersection of the Pierhead

Line and the Battery. The width of the area varies from 970 feet upstream to 0 feet downstream, with a length of 5,200 feet parallel to the Pierhead Line.

The entire area is owned by the City of New York; however, present plans indicate that it will be leased for 99 years to the Battery City Park Corporation. All facilities in the area will be demolished for the land fill project. Utilities in the area are in poor to good condition.

The depth of water along the Pierhead Line varies from 30 feet to 40 feet, while the depth of bedrock ranges from -40 feet to -70 feet. The thickness of the Hudson River silt strata varies from 3 feet to 30 feet. A land filling operation is currently under way for about one-third of the site. The remainder is expected to be filled at a later date.

Land Costs

The costs associated with site acquisition and preparation are detailed below. For the offshore areas which can be filled, the costs are broken down into four categories: demolition, fill, land fill perimeter structures and dredging. Demolition includes the destruction of both the offshore structures and the top of the bulkhead. Land fill perimeter structures consist of both the relieving platforms and rock dikes used around the boundaries of the land fill. In cases where the thickness of the Hudson River silt strata and the depth of bedrock are too great to permit filling the offshore area, costs are given for the demolition of offshore structures and for the construction of a pier platform and fenders.

General Area I: North of West 59th Street

a. Upland Area A

The cost of the air rights over the Penn Central land is

estimated to be $20 per square foot, or $871,200 per acre.[3/] The estimated construction cost of a platform over this area is approximately $570,000 per acre.

b. Offshore Area 1

A breakdown of the costs of filling and preparing Offshore Area 1 is shown below.

• Demolition	$ 2,200,000
• Fill	10,810,000
• Land fill perimeter structures	8,440,000
• Dredging	1,200,000

The above expenditures, totaling $22.65 million, are equivalent to a cost per acre of approximately $550,000, not including any charge for water rights.

General Area II: The West 30's Area

a. Upland Area B

The cost of air rights over the Penn Central land is estimated to be $20 per square foot, or $871,200 per acre. The estimated construction cost of a platform over this area is approximately $700,000 per acre.

b. Offshore Area 2

A breakdown of the costs of filling and preparing Offshore Area 2 is shown below.

• Demolition	$1,040,000
• Fill	6,920,000
• Land fill perimeter structures	5,300,000
• Dredging	800,000

[3/] This information was furnished by Mr. Early, Real Estate Manager of Penn Central.

The above expenditures, totaling $14.06 million, are equivalent to a cost of approximately $540,000 per acre.

c. Offshore Area 3

The depth of bedrock and thickness of Hudson River silt strata are great enough to discourage filling operations in Offshore Area 3. Consequently, a pier platform would be constructed. The relevant costs are shown below.

• Demolition of offshore structures	$ 960,000
• Pier platform and fenders	18,190,000

The above expenditures, totaling $19.15 million, are equivalent to a cost of approximately $1,008,000 per acre.

General Area III: The Chelsea-Gansevoort Market Area

a. Upland Area C

It is estimated that the acquisition cost of Upland Area C is $1,660,000 per acre. Demolition costs on the upland sector are estimated to be an additional $130,000 per acre.

b. Offshore Area 4

The depth of bedrock and thickness of Hudson River silt strata are great enough to discourage filling operations in Offshore Area 4. Consequently, a pier platform would be constructed. The relevant costs are shown below.

• Demolition of offshore structures	$ 600,000
• Pier platform and fenders	94,110,000

The above expenditures, totaling $94.71 million, are equivalent to a cost of approximately $1,435,000 per acre.

c. Offshore Area 5

A breakdown of the costs of filling and preparing Offshore Area 5 is shown below.

• Demolition	$3,800,000
• Fill	9,460,000
• Land fill perimeter structures	9,940,000
• Dredging	1,200,000

The above expenditures, totaling $24.4 million, are equivalent to a cost of approximately $510,000 per acre.

General Area IV: The Washington Street Renewal Project Area

a. Upland Area D

Costs are not given for Upland Area D because this land will be used in the Washington Street Renewal Project.

b. Offshore Area 6

A breakdown on the costs of filling and preparing Offshore Area 6 is shown below.

• Demolition	$ 7,280,000
• Fill	14,580,000
• Land fill perimeter structures	10,290,000
• Dredging	1,800,000

The above expenditures, totaling $33.95 million, are equivalent to a cost of approximately $460,000 per acre.

c. Offshore Area 7

Costs are not given for Offshore Area 7 because this area will be taken for the Battery Park City project.

Exhibit 2 summarizes the land cost data for the respective areas.

Exhibit 2

SUMMARY OF COST DATA

	No. of Acres	Total Cost (in millions)	Average Cost per Acre (in thous.)
General Area I: North of West 59th St.			
Entire Area	106	$116.33	$1,100
Upland Area A (Air Rights and Platform)	65	93.68	1,440
Marginal Sector	23	33.15	1,440
Inland Sector	42	60.53	1,440
Offshore Area 1 (Fill, etc.)	41	22.65	550
General Area II: The West 30's Area			
Entire Area	102	$102.33	$1,000
Upland Area B (Air Rights and Platform)	57	69.12	1,200
Marginal Sector[a]	13	0	0
Inland Sector	44	69.12	1,570
Offshore Area 2 (Fill, etc.)	26	14.06	540
Offshore Area 3 (Platform)	19	19.15	1,010
General Area III: The Chelsea-Gansevoort Market Area			
Entire Area	178	$205.03	$1,150
Upland Area C (Acquisition and Demolition)	64	85.92	1,340
Marginal Sector[a]	16	0	0
Inland Sector	48	85.92	1,790
Offshore Area 4 (Platform)	66	94.71	1,435
Offshore Area 5 (Fill, etc.)	48	24.40	510
General Area IV: The Washington St. Renewal Project Area			
Marginal Sector[a]	14	$ 0	$ 0
Offshore Area 6 (Fill, etc.)	74	33.95	460

[a] Since the marginal sectors in these areas are public streets, acquisition costs are assumed to be zero.

Evaluation of Potential Sites

In order to evaluate the 24 potential sites contained in the four general areas, a staged screening technique was formulated.

Land Area Requirements and Availability

First, sites that are not available or that do not meet land area requirements[4/] for a two-berth facility were eliminated. Exhibit 3 presents the results of the first screening stage, reducing the number of potential sites to 14.

Cost, Accessibility and Compatibility

The 14 remaining sites were then appraised in terms of three factors.

- Average cost per acre.
- Accessibility to truck traffic, ranked 1 through 4 in descending order of desirability. Includes Manhattan and non-Manhattan origins and destinations for traffic, weighted to reflect the greater importance of Manhattan traffic; does not include such factors as width of streets and traffic congestion.
- Compatibility with contiguous areas, ranked 1 through 4 in descending order of desirability. Includes expected future construction programs as well as present structures.

As Exhibit 4 indicates, General Area IV received the lowest compatibility rating because of the Washington Street Renewal Project in Upland Area D and Battery Park City (with its residential community) in

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4/ Minimum of 60 acres and 1,700-foot frontage.

Exhibit 3

EVALUATION OF 24 POTENTIAL SITES

Site	Availability	Minimum Acreage	Minimum Frontage
General Area I			
1. Entire Area	yes	yes	yes
2. Offshore Area 1 plus Marginal Sector	yes	yes	yes
3. Upland Area A	yes	yes	yes
General Area II			
4. Entire Area	yes	yes	yes
5. Offshore Area 2 and Offshore Area 3 plus Marginal Sector	yes	no	yes
6. Offshore Area 2 and Upland Area B	yes	yes	yes
7. Offshore Area 3 and Upland Area B	yes	yes	yes
8. Offshore Area 2 plus Marginal Sector	yes	no	yes
9. Offshore Area 3 plus Marginal Sector	yes	no	yes
10. Upland Area B	yes	no	yes
General Area III			
11. Entire Area	yes	yes	yes
12. Offshore Area 4 and Offshore Area 5 plus Marginal Sector	yes	yes	yes
13. Offshore Area 4 and Upland Area C	yes	yes	yes
14. Offshore Area 5 and Upland Area C	yes	yes	yes
15. Offshore Area 4 plus Marginal Sector	yes	yes	yes
16. Offshore Area 5 plus Marginal Sector	yes	yes	yes
17. Upland Area C	yes	yes	yes
General Area IV			
18. Entire Area	no	yes	yes
19. Offshore Area 6 and Offshore Area 7 plus Marginal Sector	no	yes	yes
20. Offshore Area 6 and Upland Area D	no	yes	yes
21. Offshore Area 7 and Upland Area D	no	yes	yes
22. Offshore Area 6 plus Marginal Sector	yes	yes	yes
23. Offshore Area 7 plus Marginal Sector	no	yes	yes
24. Upland Area D	no	no	yes

Exhibit 4

SUMMARY OF EVALUATION DATA FOR 14 SITES

Site	Average Cost per Acre (in thous.)	Truck Access[a]	Compatibility with Contiguous Areas[a]
General Area I			
1. Entire Area	$1,100	4	3
2. Offshore Area 1 plus Marginal Sector	870	4	3
3. Upland Area A	1,440	4	3
General Area II			
4. Entire Area	$1,000	3	2
6. Offshore Area 2 and Upland Area B	1,000	3	2
7. Offshore Area 3 and Upland Area B	1,160	3	2
General Area III			
11. Entire Area	$1,150	2	1
12. Offshore Area 4 and Offshore Area 5 plus Marginal Sector	915	2	1
13. Offshore Area 4 and Upland Area C	1,390	2	1
14. Offshore Area 5 and Upland Area C	985	2	1
15. Offshore Are 4 plus Marginal Sector	1,155	2	1
16. Offshore Area 5 plus Marginal Sector	380	2	1
17. Upland Area C	1,340	2	1
General Area IV			
22. Offshore Area 6 plus Marginal Sector	$ 385	1	4

[a] For purposes of evaluation, 1 is the best choice and 4, the worst.

Offshore Area 7, adjacent to Offshore Area 6. The cost per acre for two potential sites (16 and 22) was considerably less than that for any other site: Site 16 (General Area III: Offshore Area 5 plus Marginal Sector) averages $380,000 per acre; Site 22 (General Area IV: Offshore Area 6 plus Marginal Sector) averages $385,000 per acre.[5/] Accordingly, the choice of sites narrowed to these two. Since the costs per acre are approximately equal for the two sites (based on a facility of 60 acres), the other criteria were considered. Accessibility to truck traffic slightly favors Site 22; on the other hand, compatibility with contiguous areas favors Site 16 (assuming the construction of Battery Park City).

The final decision factor used was the comparative costs of expanding the sites from 60 acres. If three berths instead of two berths were needed, a site of approximately 90 acres would be required.[6/] Since Site 22 contains 88 acres, there would be no problem in expanding. The cost for the land in excess of 60 acres would be about $460,000 per acre. In the case of Site 16, which has 64 acres, expansion would be more expensive. Expansion would either be north into Offshore Area 4, or inland to Upland Area C. Expansion to the south of Offshore Area 5 would not be possible without destroying the modern terminal facilities of the Holland American Line. The cost of expanding into Offshore Area 4 would be approximately $1,435,000 per acre, while expanding into the inland sector of Upland Area C would cost $1,790,000 per acre.

5/ When comparing two areas of equal acreage, adjusting the marginal sector to the boundary of the offshore area rather than the inland area does not cause a significant difference in these numbers.

6/ An area of 90 acres for 3 berths assumes a horizontal facility. With the use of vertical facilities it may be found that 60 acres would provide adequate space to accommodate future demand. In that case, Offshore Area 6 would have no potential cost advantage over Offshore Area 5.

Adequate frontage for 3 berths would be no problem in either area: Offshore Area 5 has a frontage of 2,900 feet; Offshore Area 6 has a 3,520-foot frontage.

Our primary opinion at this time is that the advantages of Site 22 more than outweigh its disadvantages relative to Site 16. Consequently, Harbridge House considers Site 22 as the most desirable and feasible location for the proposed Manhattan Container Facility and has used this site as the basis for subsequent cost analyses. As can be seen from Figure 4 (p. 23), Site 22 consists of Offshore Area 6 (totaling 74 acres and bounded up upstream by an extension of Charlton Street and downstream by the south side of Pier 21) and the marginal sector (consisting of 14 acres). The entire area is owned by the City of New York. For a more detailed description, see pp. 24 and 25.

Chapter II

ALTERNATIVE CONTAINER TERMINAL SYSTEMS

Introduction

Four systems for a container terminal were identified: one, vertical in layout; and three, horizontal.

- Vertical Storage[1/]
- Horizontal Chassis
- Horizontal Straddle Carrier
- Horizontal Travel Crane

All four systems utilize the same method for loading and discharging containers from a ship tied up alongside a marginal wharf. All four systems have similar stuffing and stripping operations at the terminal except that the vertical system incorporates two overhead cranes for moving containers between the storage area and the shed. The movement of containers is included in the respective intra-terminal movement equipment requirements for the three horizontal systems.

Major Differences in Systems

The major differences among the four systems occur in the storage of containers at the terminal and the method or types of equipment used to move containers within the boundaries of the terminal.

1/ The vertical concept used in this analysis is the one developed by Containerport Development Corporation and presented to the research team and the Department of Ports and Terminals personnel in a 4 June 1969 briefing. The Containerport presentation has been modified by Harbridge House.

a. In the vertical concept, containers are stored in a high-rise structure similar to an automated parking garage. Containers are stowed and removed from storage by four elevators. Intra-terminal movement of containers is accomplished by yard tractors and chassis, except for the use of overhead cranes between storage and the stuffing shed.

b. In the horizontal chassis system, containers are stored on chassis parked in an open paved area. All intra-terminal movements are performed with tractors and chassis.

c. In the horizontal straddle carrier system, containers are stored directly on the pavement, with 50% of the containers stacked two-high. Intra-terminal movements are accomplished by straddle carriers.

d. In the horizontal travel crane system, containers are stored directly on the pavement, stacked two-high for 60% of the containers. Intra-terminal movements are accomplished in two ways: movements between the storage area and the pierside cranes or the stuffing and stripping shed are accomplished with tractors and chassis; travel cranes load and unload the containers from the chassis in the storage area.

The calculations for the storage areas required for each system are shown in Figure 5, from which it can be seen that storage area requirements range from 3 1/2 acres for a vertical facility to 44 acres for a chassis storage facility.

System Operating Concepts

The major factors which affect unit cost per ton for a container facility are:

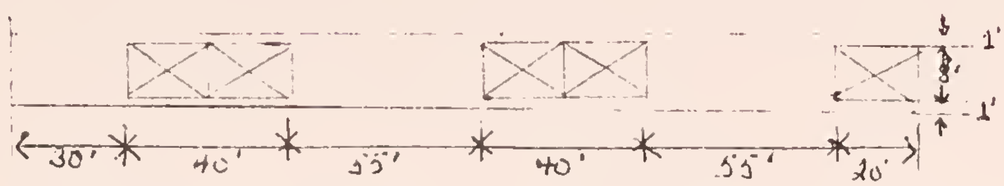
Figure 5

SPACE REQUIREMENTS FOR CONTAINER STORAGE SYSTEMS

Vertical Facility

The container storage building is 590' x 252', or 148,680 sq. ft. With a truck aisle at each end of the building, the total area is about 3.5 acres.

Chassis Storage

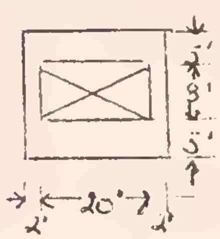


5 containers in an area 10' x 240' = 480 sq. ft. per container = 91 containers per acre.

4,000 20' equivalent containers will need 44.0 acres.

The above storage area allows for as much as 80% of the 4,000 20' equivalents to be in the form of 40' containers.

Straddle Carrier



One container in an area 24' x 18' = 432 sq. ft per container = 101 containers per acre.

If one-half the containers are stacked two-high this gives 288 sq. ft. per container = 151 containers per acre.

4,000 20' equivalent containers will need 26.5 acres.

Figure 5 (Continued)

Travel Crane

5 containers in an area 65' x 24' = 312 sq. ft. per container = 140 containers per acre.

If 3 containers in each row are stacked two-high that will give

8 containers in the same area -- 195 sq. ft. per container = 223 containers per acre.

4,000 20' equivalents will need 17.9 acres.

By spacing containers closer than shown above, or by using 40' rather than 20' containers, space is saved that can be used for turning space for the travel cranes.

- The annual level of container throughput.
- The operating methods of each type of facility with the corresponding equipment and labor requirements.

The major restriction on container facility throughput is the number of containers that can be stored in the terminal at one time.

In order to calculate the throughput, assumptions were made regarding the length of time a ship's cargo of containers remains in the terminal before or after being moved to or from the ship.

Exported Cargo

No. of days before ship loaded	5	4	3	2	1	0
% of ship's cargo stored at end of day	10%	20%	50%	80%	100%	0%

Imported Cargo

No. of days after ship unloaded	0	1	2	3	4	5	6	7
% of ship's cargo stored at end of day	95%	85%	75%	55%	35%	15%	5%	0%

These distributions were based on current experience at horizontal container terminals. With more advanced container terminal facilities which could deliver and receive containers to and from truckers quicker than with present systems, it is possible that these cargo distributions will change. However, the cargo of consignees who purposely leave their cargo at the terminals, using the terminal as a warehouse for their goods, will be little affected by a more efficient terminal operation. In addition, even with operations more efficient than at present, peak demands will cause waiting. Therefore, it is not obvious to what extent a more efficient operation will change the distribution of cargo pick-ups and deliveries.

Thus, daily variations in the amount of cargo stored mean that throughput calculations must take into account peaks of cargo traffic since a constant flow of ships cannot be counted on--either weekly or seasonally. Maximum storage capacity must thus be reserved for predictable peak periods. Sample calculations were performed for annual throughputs of four million, three million, two million and one million long tons to find the maximum level of utilization which could also absorb peaks of traffic. Assuming ten long tons per 20-foot container, these tonnages correspond to 400,000, 300,000, 200,000 and 100,000 20-foot equivalent containers per year.

Other assumptions used in calculating Exhibits 5-10 were:

- A five-day week and a 50-week year.
- The number of 20-foot containers are counted at the start of the specified working day.
- The item, Exports, refers to the number of 20-foot containers waiting to be loaded.
- The item, Imports, refers to the number of containers remaining in the storage area waiting to be picked up after being unloaded.
- Deck cargo of 200 20-foot equivalents per ship must be unloaded before loading can begin.
- All ships are assumed to be waiting to be unloaded or loaded at the start of the working day.

To simplify calculations, it is assumed that each ship--A, B, etc.--belongs to a series of ships serving a specified trade route of a steamship company; therefore, cargo arriving for a particular ship cannot

go out on another ship. In addition, it is assumed that this schedule is constant from week to week.

Because export cargo arrives for five days previous to the docking of the ship, the figures for each block of each day include:

- Export tonnage waiting to be loaded on the respective ships arriving that week.
- Export tonnage waiting to be loaded on the respective ships arriving the following week. (Indicated by parenthesis.)

Import cargo takes seven days to be cleared out of the storage area. Thus, import figures for each block of each day can include:

- Import tonnage unloaded from respective ships arriving that week.
- Import tonnage unloaded from the previous week's(s') ships. [Indicated by brackets.]

Four Million Tons Annual Throughput. The minimum storage area required can be calculated by assuming an even distribution of ship unloading and loading; 8,000 20-foot equivalents per week would result in 1,600 20-foot container movements per day, or 800 loaded and 800 unloaded. If it is assumed that one ship of appropriate size arrives each morning and is worked by four port cranes, each averaging 20 container movements per hour (ten loaded and ten unloaded during the dual cycle), the ship will be turned around in 20 hours of work. Consequently, the container facility (or specifically the port cranes) will operate about 100 hours per week. Using the distributions for cargo arriving and departing from the container terminal described above, four million tons annual throughput will require a minimum storage capacity of 5,000 20-foot equivalents. (See Exhibit 5.)

Exhibit 5

FOUR MILLION TONS ANNUAL THROUGHPUT--EVEN DISTRIBUTION[a]
(8,000 20-Foot Equivalents per Week)

Ship	Type of Cargo	No. of 20-Foot Equivalents at Start of Each Day				
		Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports	800	(80)	(160)	(400)	(640)
	Imports	[280]	760 [120]	680 [40]	600	440
B	Exports	640	800	(80)	(160)	(400)
	Imports	[440]	[280]	760 [120]	680 [40]	600
C	Exports	400	640	800	(80)	(160)
	Imports	[600]	[440]	[280]	760 [120]	680 [40]
D	Exports	160	400	640	800	(80)
	Imports	[680] [40]	[600]	[440]	[280]	760 [120]
E	Exports	(80)	(160)	(400)	(640)	(800)
	Imports	760 [120]	680 [40]	600	440	280
Total		5,000	5,000	5,000	5,000	5,000

[a] Eight hundred 20-foot equivalents are loaded and unloaded per ship. One ship arrives by start of each day, Monday through Friday. Ship A unloads/loads on Monday; Ship B, Tuesday; Ship C, Wednesday; Ship D, Thursday; Ship E, Friday.

Note that space provision must be made for unloading 200 20-foot equivalents before the loading of cargo can start. Thus, a total storage capacity of 5,200 20-foot equivalents would be necessary. Since this capacity surpasses the 4,000 20-foot containers being considered, four million tons seem to be an excessively high throughput for the systems under evaluation, particularly since the scheduling of ships to permit 100 hours of work for all cranes each week would be a difficult task in itself.

Three Million Tons Annual Throughput. If it is assumed that one ship per day arrives four days of the week with each ship loading and unloading 750 20-foot containers, the facility (or specifically, the port cranes) will work about 75 hours a week. Under these conditions, at the peak period of the week, space for 4,064 20-foot equivalents will be required (3,864 containers as per Exhibit 6 and additional deck cargo of 200 20-foot equivalents).

If it is assumed that the four ships arrive, two on Monday and two on Wednesday, the space required at the peak period is 4,302 20-foot equivalents, if additional deck loads of 200 containers per ship are included. (See Exhibit 7.)

The calculations presented in Exhibits 6 and 7 only vary cargo flow within a period of a week. If seasonal fluctuations exist in the flow of containers through a facility, peak demands on a storage area will be greater. However, for the purposes of this study, we have assumed that the storage space of 4,000 20-foot equivalents can handle a maximum of three million tons per year.

Exhibit 6

THREE MILLION TONS ANNUAL THROUGHPUT--EVEN DISTRIBUTION[a/]
(6,000 20-Foot Equivalents per Week)

	Type of	No. of 20-Foot Equivalents at Start of Each Day				
Ship	Cargo	Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports	750	(75)	(150)	(375)	(600)
	Imports	[263]	712 113	637 38	563	413
B	Exports	600	750	(75)	(150)	(375)
	Imports	[413]	263	712 113	637 38	563
C	Exports	375	600	750	(75)	(150)
	Imports	[563]	413	263	712 113	637 38
D	Exports	150	375	600	750	(75)
	Imports	[637] [38]	563	413	263	712 113
Total		3,789	3,864	3,751	3,676	3,676

a/ Seven hundred and fifty 20-foot equivalents are loaded and unloaded per ship. One ship arrives by start of each day, Monday through Thursday. Ship A unloads/loads on Monday; Ship B, Tuesday; Ship C, Wednesday; Ship D, Thursday.

Exhibit 7

THREE MILLION TONS ANNUAL THROUGHPUT--PEAK LOADING[a]
(6,000 20-Foot Equivalents per Week)

Ship	Type of Cargo	No. of 20-Foot Equivalents at Start of Each Day: Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports		(75)	(150)	(375)	(600)
		750				
	Imports		712	637	563	413
		[263]	113	38		
B	Exports		(75)	(150)	(375)	(600)
		750				
	Imports		712	637	563	413
		[263]	113	38		
C	Exports				(75)	(150)
		375	600	750		
	Imports				712	637
		[563]	413	263	113	38
D	Exports				(75)	(150)
		375	600	750		
	Imports				712	637
		[563]	413	263	113	38
Total		3,902	3,826	3,676	3,676	3,676

a/ Seven hundred and fifty 20-foot equivalents are loaded and unloaded per ship. Ships A and B unload/load on Monday; Ships C and D unload/load on Wednesday.

Two Million Tons Annual Throughput. If it is assumed that three ships arrive per week--one each day for three consecutive days--and that the first ship unloads and loads 800 20-foot equivalents and the other two ships, 600 20-foot equivalents--the peak period will require space for 2,640 20-foot equivalents plus an additional deck load of 200 20-foot equivalents, increasing the amount to 2,840 containers. (See Exhibit 8.) Such an annual throughput of two million tons will keep the port cranes operating 50 hours per week.

Although the amount of space needed for the above estimate of a 2-million-ton throughput is only for 2,840 20-foot equivalent containers, a fluctuation in ship arrivals and container loads could greatly increase the required storage space. For example, if three ships each unloaded and loaded 1,000 20-foot equivalents and two ships arrived the day after the first, the storage space required would be 4,300 containers including deck cargo of 400 containers. (See Exhibit 9.) Consequently, a proposed container facility with storage space for 4,000 20-foot equivalents would have difficulty operating with an annual throughput of two million tons if large seasonal fluctuations occurred. Based on these considerations, the most likely maximum throughput appears to be two million tons per year. This volume of cargo traffic is double the throughput currently processed at existing container facilities, which average approximately 500,000 tons per year per berth.

One Million Tons Annual Throughput. On the average, one million tons annual throughput requires only 1,000 20-foot equivalents loaded and 1,000 unloaded per week. If one ship handled this cargo, the peak period

Exhibit 8

TWO MILLION TONS ANNUAL THROUGHPUT--UNEVEN DISTRIBUTION[a/]
(4,000 20-Foot Equivalents per Week)

Ship	Type of Cargo	No. of 20-Foot Equivalents at Start of Each Day: Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports				(80)	(160)
		400	640	800		
	Imports				760	680
		[600]	440	280	120	40
B	Exports					(60)
		120	300	480	600	
	Imports					570
		[510]	450	330	210	90
		[30]				
C	Exports	60	120	300	480	600
	Imports	570	510	450	330	210
		[90]	30			
Total		2,380	2,490	2,640	2,580	2,410

a/ One ship arrives by start of each day, Wednesday through Friday. Ship A unloads/loads 800 20-foot equivalents on Wednesday; Ships B and and C, 600 20-foot equivalents on Thursday and Friday, respectively.

Exhibit 9

TWO MILLION TONS ANNUAL THROUGHPUT--PEAK LOADING[a]
(4,000 20-Foot Equivalents per Week)

Ship	Type of Cargo	No. of 20-Foot Equivalents at Start of Each Day Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports				(100)	(200)
		500	800	1,000		
	Imports				950	850
		[750]	550	350	150	50
B	Exports					(100)
		200	500	800	1,000	
	Imports					950
		[850]	750	550	350	150
		[50]				
C	Exports					(100)
		200	500	800	1,000	
	Imports					950
		[850]	750	550	350	150
		[50]				
Total		3,450	3,850	4,050	3,900	3,500

a/ Ship A unloads/loads 1,000 20-foot equivalents on Wednesday; Ships B and C unload/load 1,000 20-foot equivalents on Thursday.

would require space for 1,350 20-foot equivalents at the arrival of the ship. (See Exhibit 10.) An additional deck load of 200 20-foot equivalents would increase the space required to 1,550. If several ships docked each week, seasonal demand fluctuations could greatly increase the storage space needed. However, at this level of throughput all four systems would be significantly underutilized.

Exhibit 10

ONE MILLION TONS ANNUAL THROUGHPUT--UNEVEN DISTRIBUTION[a/]
(2,000 20-Foot Equivalents per Week)

Ship	Type of Cargo	No. of 20-Foot Equivalents at Start of Each Day				
		Monday	Tuesday	Wednesday	Thursday	Friday
A	Exports	100	200	500	800	1,000
	Imports	950	850	750	550	350
		[150]	50			
Total		1,200	1,100	1,250	1,350	1,350

a/ Ship A unloads/loads 1,000 20-foot equivalents on Monday.

Chapter III

COST ANALYSIS OF ALTERNATIVE CONTAINER FACILITIES

Introduction

This chapter presents the results of the second phase of the Manhattan Container Facility Feasibility Study--a cost analysis of various types of container facilities. The purpose of this phase was to develop capital cost estimates for both horizontal and vertical container terminal design concepts in order to compare unit costs per ton incurred at a facility located on Manhattan with those incurred at a facility located in Port Elizabeth.

Capital Cost Estimates

Based on the operational concept described in Chapter II, capital cost estimates were developed for each of the four types of container facility, assuming the following land area requirements.

- Vertical Storage — 29 acres
- Horizontal Chassis — 68 acres
- Horizontal Straddle Carrier — 50 acres
- Horizontal Travel Crane — 42 acres

Land Fill

This category of costs includes: demolition of existing structures on the selected site; dredging incident to the field operation; the purchase and placement of the fill itself; and the land fill area retaining structures such as rock dikes and cofferdams.

Two assumptions have been made regarding land fill. First, it has been assumed that the land area required by each system will be provided by land fill operations. No use of available marginal sector land has been made, since use of any such land area, while serving to reduce the cost of land fill for each system, would be limited because of interference with the existing elevated highway structure and marginal street. Second, it has been assumed that the land will be filled according to the staged fill process recommended in the Manhattan North River Study.

The costs of land fill for each system vary essentially with the land area required by each system. (See Exhibit 11.)

Exhibit 11

CAPITAL COSTS OF LAND FILL
(Dollars in Thousands)

		Horizontal		
	Vertical Facility	Chassis	Straddle Carrier	Travel Crane
Demolition	$ 4,800	$ 6,165	$ 5,480	$ 4,800
Dredging, Sand & Rock Fill, and Rock Dikes and Cofferdam	8,773	18,678	14,134	12,112
Subtotal	$13,573	$24,843	$19,614	$16,912
Contingency Allowance (15%)	2,036	3,726	2,942	2,537
Total	$15,609	$28,569	$22,556	$19,449

Site Improvements

Costs included in the site improvement category are for paving, water supply and drainage, and yard lighting and power. Since the magnitude of these costs are dependent upon the land areas required by each system, the capital cost estimates for these items vary accordingly.

The capital costs (including a 15% contingency allowance) for site improvements for the four types of container facilities are presented in Exhibit 12.

Exhibit 12

CAPITAL COSTS OF SITE IMPROVEMENTS
(Dollars in Thousands)

	Vertical Facility	Horizontal Chassis	Horizontal Straddle Carrier	Horizontal Travel Crane
Paving	$ 600	$1,856	$1,333	$1,100
Water Supply, Drainage, Yard Lighting and Power	500	1,133	833	700
Subtotal	$1,100	$2,989	$2,166	$1,800
Contingency Allowance (15%)	165	448	325	270
Total	$1,265	$3,437	$2,491	$2,070

Buildings and Structures

In the buildings and structures category for all four container facilities, provision was made for: 25,000 square feet of administrative space; 25,000 square feet of maintenance space; 155,000 square feet for covered stuffing and stripping operations, control tower, computer installation; and 1,700 linear feet of wharf and pile-support craneway.

Since all buildings and structures are essentially identical for the three horizontal terminal systems, their capital investments are equal. The capital cost estimate for the three horizontal systems differs from that for the vertical system--with its investment in the vertical storage structure, associated elevators and the overhead cranes used to move containers into and out of the stuffing and stripping shed. (See Exhibit 13.)

Exhibit 13

CAPITAL COSTS OF BUILDINGS AND STRUCTURES
(Dollars in Thousands)

	Vertical Facility	Horizontal Systems
Administrative Building and Stuffing/Stripping Shed	$ 3,000	$ 3,000
Maintenance Building	500	500
Storage Structure[a/]	15,400	-
Control Tower and Computer Installations	850	850
Berths (including wharf and pile-supported craneway)	5,050	5,050
Subtotal	$24,800	$ 9,400
Contingency Allowance (15%)	3,720	1,410
Total	$28,520	$10,810

a/ Includes 4 Otis elevators for the vertical facility.

Equipment

The equipment requirements in each system are based on an annual throughput of three million tons with all four port cranes being operated, and containers moving simultaneously between the pier and the storage area, between the storage area and the stuffing and stripping shed, and between the storage area and the gate.

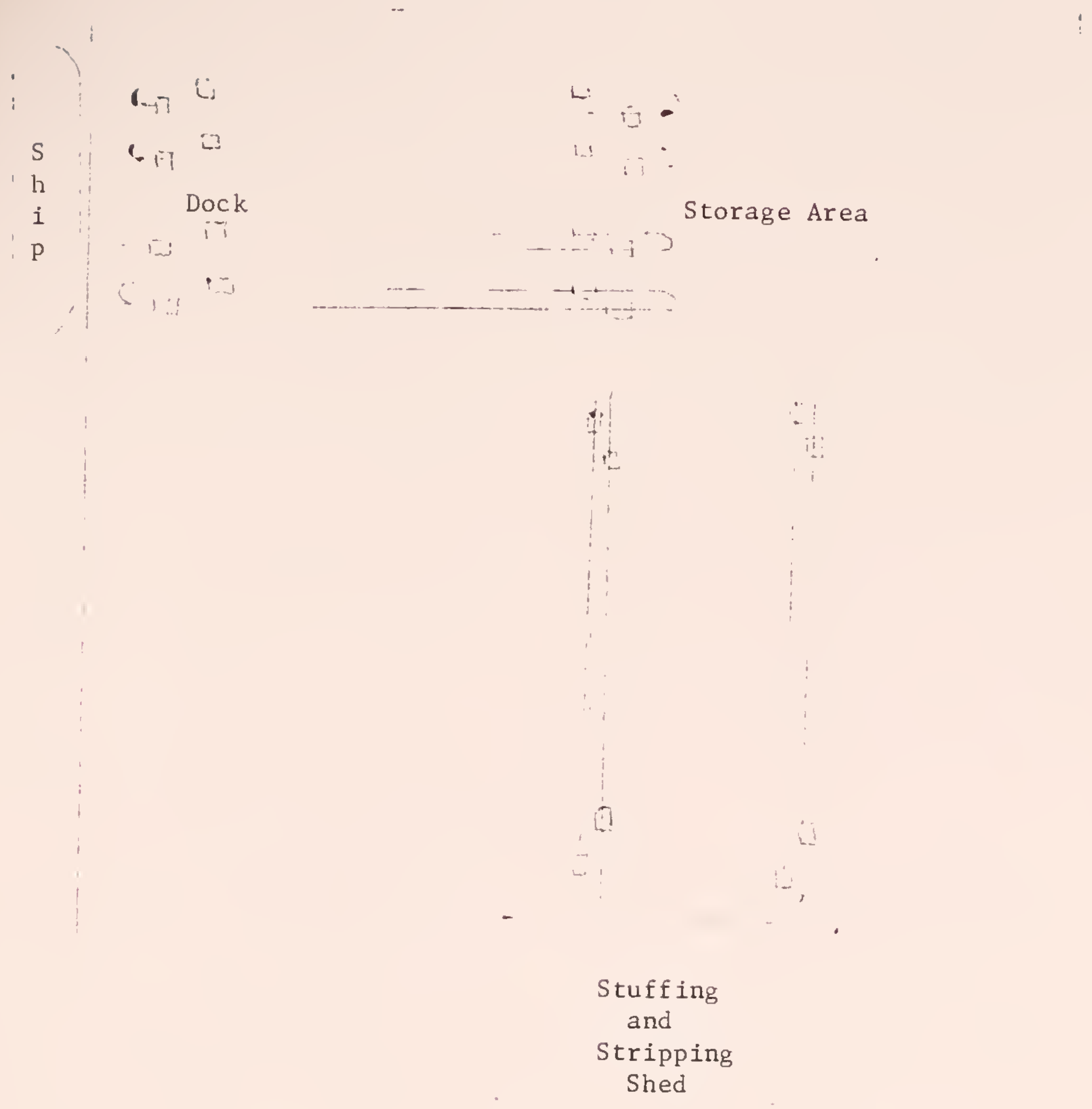
In order to break down the cost of moving a container through the terminal, all the labor and equipment requirements have been placed in one of six categories.

a. Ship loading and discharging of containers.

b. Movement of containers between dock and storage areas. In each system, "loops" of four vehicles per port crane, or 16 vehicles per container system, are used to move containers between the dock and the

Figure 6

"Loops" of Vehicles in Horizontal Systems



Not drawn to scale.

storage area. These vehicles are tractors and chassis, except in the system using straddle carriers (plus tractors).

c. Handling of containers in the storage area (related to the storage-area-to-dock movement). In the storage area itself, additional equipment is needed for each system except the straddle carrier system. The vertical system requires four elevators in the storage building. Since the chassis used in the movement of containers are as a rule the property of the shipper or the steamship line, the cost to the container facility operator is mainly that of providing chassis for the stuffing and stripping operations. If it is assumed that 50% of the containers outbound are stuffed and 25% of the containers inbound are stripped, and if provision is made for handling an annual 3,000,000-ton throughput on a peak loading basis (see Exhibit 7), then 1,154 chassis are required, assuming that one-half are for 20-ft. containers and the remainder are for 40-ft. containers. Adding the 24 chassis needed for the loop movements gives a total of 1,178 chassis.

d. Movement of containers between storage area snd stuffing and stripping shed. (It is assumed that fully loaded containers must pass through the storage area when moving to or from the stuffing and stripping shed.) In the case of the three horizontal systems--chassis, straddle carrier and travel crane--two additional "loops" of four vehicles each, or a total of eight vehicles, are used to carry containers between the storage area and the stuffing and stripping shed. The vehicles used for the storage area to stuffing and stripping shed "loops" are tractors plus chassis for the chassis and travel crane systems and straddle carriers for the straddle carrier system. Two overhead cranes perform this operation in the vertical system.

e. Handling of containers in the storage area (related to the storage-area-to-gate movement).

f. Movement of containers between the storage area and gate. In all systems except the straddle carrier system the movement between the storage area and the gate is performed by outside truckers who pick up and deliver the containers. In the straddle carrier system, two more loops of four straddle carriers each have been added to carry containers between the storage area and the gate.

The travel crane system requires 12 travel cranes in the storage area, six to handle the containers moving in the four loops to the port cranes, two to handle the containers moving in the two loops to the stuffing and stripping shed, and four to handle container movement between the storage area and the gate. The travel crane system needs additional chassis on hand at the stuffing and stripping shed. Since the shed has a capacity of 96 20-foot equivalents, 72 extra chassis (48 20-foot chassis and 24 40-foot chassis) are required.

The equipment data, shown in Exhibit 14, generally represent the maximum requirements since an interchange of equipment can take place between segments. For example, when ships are not at the docks, all the equipment in the storage-to-dock loops can be used elsewhere in the system. In addition, when the berths are empty and the arrival of a ship is expected, equipment can be used to move containers to be exported from the storage area to the dock area. Then, when the ship arrives, less than the normal amount of equipment will be needed in the storage-area-to-dock loops. If ships arrive with sufficient intervals between them, the amount of equipment necessary for the total terminal system can be reduced by preparing ahead for each ship arrival.

Exhibit 14

EQUIPMENT REQUIREMENTS FOR CONTAINER FACILITIES

	Vertical Facility	Horizontal: Chassis	Horizontal: Straddle Carrier	Horizontal: Travel Crane
Pier Cranes	4	4	4	4
Tractors	16	24	-	24
Chassis	16	1,178	-	96
Straddle Carriers	-	-	32	-
Travel Cranes	-	-	-	12
Overhead Cranes	2	-	-	-

The equipment category of costs also provides for pier cranes, forklift trucks for the stuffing and stripping operations and maintenance shop equipment--identical for all four systems. The equipment costs based on the operating concepts described above are summarized in Exhibit 15.

Exhibit 15

CAPITAL COSTS OF EQUIPMENT
(Dollars in Thousands)

	Vertical Facility	Horizontal: Chassis	Horizontal: Straddle Carrier	Horizontal: Travel Crane
Pier Cranes ($1,000,000 each)	$4,000	$ 4,000	$4,000	$4,000
Tractors ($11,000 each)	176	264	-	264
Chassis ($3,300 each)	53	3,887	-	317
Straddle Carriers ($110,000 each)	-	-	3,520	-
Travel Cranes ($225,000 each)	-	-	-	2,700
Overhead Cranes ($100,000 each)	200	-	-	-
Maintenance Shop Equipment and Fork Lift Trucks	600	600	600	600
Subtotal	$5,029	$ 8,751	$8,120	$7,881
Contingency Allowance (15%)	754	1,313	1,218	1,182
Total	$5,783	$10,064	$9,338	$9,063

To develop estimates for each system assuming a 20-, 30- and 40-year life span for the total facility, it was necessary to make assumptions regarding the life span of each type of equipment as follows.[1]

Pier Crane	30 years
Travel Crane	15 years
Straddle Carrier	7.5 years
Tractor	7.5 years
Chassis	7.5 years
Forklift Truck	7.5 years
Maintenance Shop Equipment	7.5 years
Overhead Crane	Same as Facility

Exhibit 16 shows the capital cost estimates for the four types of container systems.

Exhibit 16

SUMMARY OF CAPITAL COST ESTIMATES
(Dollars in Thousands)

		Horizontal		
	Vertical Facility	Chassis	Straddle Carrier	Travel Crane
Land Fill	$15,609	$28,569	$22,556	$19,449
Site Improvements	1,265	3,437	2,491	2,070
Buildings and Structures	28,520	10,810	10,810	10,810
Subtotal	$45,394	$42,816	$35,857	$32,329
Equipment, Assuming a Facility Life of:				
20 Years	$ 5,840	$17,636	$15,702	$10,828
30 Years	8,643	26,455	23,552	16,243
40 Years	11,447	35,273	31,402	21,657
Total Capital Costs, Assuming a Facility Life of:				
20 Years	$51,234	$60,452	$51,559	$43,157
30 Years	54,037	69,271	59,409	48,572
40 Years	56,841	78,089	67,259	53,986

1/ Where necessary, it was assumed that the value of any equipment remaining at the end of the life span of the facility would equal its unamortized value.

Fixed Cost Estimates

The next step was to estimate annual fixed costs for each of the container systems, assuming 20-, 30- and 40-year life spans for the facilities. In addition, estimates were developed for three different treatments of land fill costs.

a. Assuming that the land created for the facility does not depreciate in value and that it is available for other uses at the end of the life span of the container terminal, the cost of land fill is not amortized over the facility's life span. However, interest of seven percent per year on the land fill cost is included as an annual fixed cost.

b. Based on the assumption that the City should recover its investment in land creation as well as capital construction, the cost of land fill is amortized over the facility's life span and annual interest of seven percent is charged on the unamortized portion of the land fill cost.

c. To enable comparison with the container terminal located at Port Elizabeth (or any other location where the cost of land creation and the method of its recovery are similar to those of the New York Port Authority), an annual rental of $.20 per square foot is charged for land. This rental is considered to cover only the cost of land fill and the initial paving; it does not include the costs of buildings, structures, craneways and equipment, nor does it cover the annual fixed maintenance costs for paved surfaces.

In addition to providing for the above assumptions regarding land fill costs, the annual fixed cost estimates include: amortization of total capital costs over the appropriate life span of the facility; the

average annual interest at seven percent on the unamortized portion of the capital invested; annual maintenance costs for paving, for the administration building, the stuffing and stripping shed and the maintenance building, and in the case of the vertical system, for the storage structure; and the costs of permanent terminal employees (such as administrative, security, control, maintenance, delivery and receiving personnel). Detailed fixed maintenance and staff costs are shown in Exhibit 17. All other labor--such as drivers, ship gangs, crane operators and elevator operators--are considered to be variable operating costs.

Exhibit 17

FIXED MAINTENANCE AND STAFF COSTS
(Dollars in Thousands)

		Horizontal		
	Vertical Facility	Chassis	Straddle Carrier	Travel Crane
Fixed Maintenance Costs				
Paving	$ 100	$ 309	$ 222	$ 183
Administration Building, Stuffing and Stripping Shed and Maintenance Building	50	50	50	50
Vertical Storage Structure	20	-	-	-
Subtotal	$ 170	$ 359	$ 272	$ 233
Fixed Staff Costs				
Control	$ 40	$ 60	$ 60	$ 60
Security	96	144	128	128
Yard	-	60	40	30
Total Administrative Staff	240	240	240	240
Maintenance	20	60	80	80
Gate Personnel	160	160	160	160
Personnel on Delivery and Receiving Docks	640	640	640	640
Subtotal	$1,196	$1,364	$1,348	$1,338
Total	$1,366	$1,723	$1,620	$1,571

Exhibit 18, which summarizes the annual fixed costs for each of the four systems, indicates that for a 20-year life span annual fixed costs on the unamortized land fill basis are lower than on the amortized basis, while for the 30- and 40-year life spans annual fixed costs are lower on the amortized land assumption than on the unamortized basis. Accordingly, the remainder of the analysis compares the 20-year figures based on unamortized land fill costs and the 30- and 40-year data based on amortized land fill costs with the fixed costs on a rental basis.

Exhibit 18

SUMMARY DATA FOR ANNUAL FIXED COSTS
(Dollars in Thousands)

	Vertical Facility	Horizontal Chassis	Horizontal Straddle Carrier	Horizontal Travel Crane
20-Year Facility Life				
Unamortized Land Fill Costs	$5,485	$6,168	$5,441	$4,885
Amortized Land Fill Costs	5,720	6,596	5,779	5,176
Fixed Rental ($0.20 per sq. ft.)	4,594	4,602	4,184	3,796
30-Year Facility Life				
Unamortized Land Fill Costs	$4,985	$5,931	$5,219	$4,671
Amortized Land Fill Costs	4,959	5,883	5,181	4,638
Fixed Rental ($0.20 per sq. ft.)	4,104	4,396	3,985	3,600
40-Year Facility Life				
Unamortized Land Fill Costs	$4,735	$5,812	$5,109	$4,563
Amortized Land Fill Costs	4,579	5,526	4,883	4,368
Fixed Rental ($0.20 per sq. ft.)	3,859	4,293	3,886	3,501

Operating Cost Estimates

Operating costs (consisting of labor, fuel and variable maintenance) for each category of terminal operations were estimated for each system. Several general assumptions were made regarding the operating cost elements.

Operating labor cost--e.g., ship gangs and vehicle drivers--varies with volume of cargo; payroll costs for maintenance, control and yard duty men were considered to be fixed. It was also assumed that operating personnel worked the same number of hours as the dock crane was operated. An average rate of $6 per man-hour was used, reflecting 50% of the labor hours at a normal rate of $4.80 per hour and 50% at an overtime rate of $7.20 per hour.

Fuel costs were calculated on the basis of $2 per hour for each tractor, $3 per hour for each travel crane, $4 per hour for each straddle carrier, and $6 per hour for each port crane. The electrical power for each overhead crane and for each elevator in the vertical container facility system was estimated at $6.25 per hour and $12.50 per hour, respectively. Further, all equipment--like labor--was assumed to operate a number of hours equal to that of the port crane.

An operating maintenance cost equal to 5% of the purchase price of a piece of equipment was estimated to be incurred for every 2,000 hours of equipment operating time. This includes the cost of spare parts, lubricants, tires, and so forth, but not the cost of labor which is performed by a permanent staff and is therefore part of the fixed annual cost.

<u>Load/Unload</u>

This category includes the costs associated with the operation of the port crane. A ship gang of 18 men plus three clerical personnel and two mechanics are assigned to each crane, which moves 20 units per hour (i.e., ten units are unloaded and ten units loaded per hour). It was assumed that the operating rate of the port cranes would be the limiting factor in the flow rate of container movement in the terminal. The load/

unload operating costs are the same for all four systems, since identical equipment and labor force are used. Thus, for a 20-ft. container:

Labor Costs	=	$6.90
Fuel Costs	=	0.30
Maintenance Costs	=	1.25

Movement Between Dock and Storage Area

The labor requirement for this movement consists of five drivers (including one relief driver) who operate the four vehicles assigned to each port crane. Since each system uses an equal number of drivers per port crane, this labor cost is equal for all four systems.

The costs for fuel and maintenance are equal for the three systems--vertical, chassis and travel crane--using tractors and chassis in this function; these costs are higher for the straddle carrier because of the higher fuel and maintenance costs associated with these larger and more complex pieces of equipment. Therefore, for a 20-ft. container:

Labor Costs (for all systems)	=	$1.50
Fuel Costs		
Vertical, Chassis and Travel Crane	=	$0.40
Straddle Carrier	=	0.80
Maintenance Costs		
Vertical, Chassis and Travel Crane	=	$0.07
Straddle Carrier	=	0.55

Storage Area Handling--Dock

This function is related to the movement between the dock and the storage area.

In the vertical system, labor, fuel and maintenance costs are incurred in the operation of the four elevators used to move containers in or out of storage. The cost estimates assume four elevator operators

plus two relief operators and movements of 160 units per hour (or 40 per elevator. Since two elevators can handle the 80 containers moving between the dock and the storage area, only one-half the operating costs are included here.

The only cost in this category for the chassis system is maintenance of the 1,154 chassis required for storage of the containers handled in the stuffing and stripping operations (see p. 56).

In the straddle carrier system, the handling of containers in the storage area is performed by the same personnel and the same equipment that perform the other container movements and, therefore, no additional operating costs are incurred in the storage area.

Operating costs in the travel crane system include those incurred in operating six travel cranes (three relief operators are included in labor costs) and in maintaining the six travel cranes and the 72 chassis used to store containers at the stuffing and stripping shed.

Thus, for each 20-foot unit:

Labor Costs:		
Vertical Facility	=	$0.23
Travel Crane	=	0.68
Fuel Costs		
Vertical Facility	=	$0.31
Travel Crane	=	0.23
Maintenance Costs		
Vertical Facility	=	$0.53
Chassis	=	1.19
Travel Crane	=	0.42

Movement Between Storage Area and Stuffing and Stripping Shed

The three horizontal systems use eight vehicles with ten drivers to perform this operation; in addition, the travel crane system uses two travel cranes and three operators.

The vertical system is relatively unique in this category of operation in that it only uses two overhead cranes and three operators. It should be noted that the two overhead cranes can only move a total of 30 units per hour. However, since, on the average, 37½% of all containers are stuffed and stripped, the two overhead cranes can handle all the movements necessary for a facility with four port cranes moving 80 containers per hour.

The operating costs for the movement between storage area and stuffing/stripping shed are summarized below.

Labor Costs		
Vertical Facility	=	$0.23
Chassis, Straddle Carrier	=	0.75
Travel Crane	=	0.98
Fuel Costs		
Vertical Facility	=	$0.16
Chassis	=	0.20
Straddle Carrier	=	0.40
Travel Crane	=	0.28
Maintenance Costs		
Vertical Facility	=	$0.06
Chassis	=	0.04
Straddle Carrier	=	0.28
Travel Crane	=	0.18

Storage Area Handling--Gate

This function is related to the movement between the storage area and the gate. The travel crane system uses four travel cranes to perform this function. The vertical facility uses the elevators to accomplish this task (see p. 65). Since the straddle carrier and chassis systems require no extra equipment for this function, there are no charges incurred here; i.e., the labor used for this storage area handling is included in the movement to the storage area.

These costs are as follows:

Labor Costs

Vertical Facility	=	$0.23
Travel Crane	=	0.45

Fuel Costs

Vertical Facility	=	$0.31
Travel Crane	=	0.15

Maintenance Costs

Vertical Facility	=	$0.53
Travel Crane	=	0.28

Movement Between Storage Area and Gate

Since the systems other than the straddle carrier use outside truckers to accomplish this container movement, there is no charge for this function. The straddle carrier system uses two loops of four vehicles each to provide this function.

The straddle carrier costs are:

Labor Costs	=	$0.75
Fuel Costs	=	0.40
Maintenance Costs	=	0.28

The operating costs per unit (i.e., per 20-ft. container) are presented in Exhibit 19.

Cost-Per-Ton Comparisons

Operating Cost Per Ton

The operating costs presented in Exhibit 19 are based on a unit which consists of a 20-foot container. In Exhibit 20 these costs have been converted to cost per ton of cargo (it was assumed that the average cargo in a 20-foot container was 10 long tons) where: a) 100% of the containers handled by a facility are 20-foot units; b) 50% are 20-foot and 50% are 40-foot units; and c) 100% are 40-foot units.

Exhibit 19

OPERATING COSTS PER 20-FOOT CONTAINER PASSING THROUGH THE FACILITY

	Vertical Facility				Chassis			
	Labor	Fuel	Mainte-nance	Sub-total	Labor	Fuel	Mainte-nance	Sub-total
Unload/Load by Port Crane	$6.90	$0.30	$1.25	$ 8.45	$6.90	$0.30	$1.25	$ 8.45
Movement between Dock and Storage Area	1.50	0.40	0.07	1.97	1.50	0.40	0.07	1.97
Storage Area Handling Related to Dock Movement	0.23	0.31	0.53	1.07	-	-	1.19[a/]	1.19[a/]
Movement between Storage Area and Stuffing and Stripping Shed	0.23	0.16	0.06	0.45	0.75	0.20	0.04	0.99
Storage Area Handling Related to Gate Movement	0.23	0.31	0.53	1.07	-	-	-	-
Movement between Storage Area and Gate	-	-	-	-	-	-	-	-
Total				$13.01				$12.60

	Straddle Carrier				Travel Crane			
Unload/Load by Port Crane	$6.90	$0.30	$1.25	$ 8.45	$6.90	$0.30	$1.25	$ 8.45
Movement between Dock and Storage Area	1.50	0.80	0.55	2.85	1.50	0.40	0.07	1.97
Storage Area Handling Related to Dock Movement	-	-	-	-	0.68	0.23	0.42	1.33
Movement between Storage Area and Stuffing and Stripping Shed	0.75	0.40	0.28	1.43	0.98	0.28	0.18	1.44
Storage Area Handling Related to Gate Movement	-	-	-	-	0.45	0.15	0.28	0.88
Movement between Storage Area and Gate	0.75	0.40	0.28	1.43	-	-	-	-
Total				$14.16				$14.07

a/ See p. 56.

Exhibit 20

OPERATING COST PER TON

System	Container Mix: 100% = 20-Ft. Units	50% = 20-Ft. Units 50% = 40-Ft. Units	100% = 40-Ft. Units
Vertical Facility	$1.301	$0.976	$0.651
Chassis	1.260	0.945	0.630
Straddle Carrier	1.416	1.062	0.708
Travel Crane	1.407	1.055	0.704

Since the differences in per-ton operating costs are small, they will not offset differences in capital costs, and any large differences in total costs must thus be ascribed to the capital costs.

Total Cost Per Ton

Total cost-per-ton data for the four systems represent the sum of operating costs per ton (see Exhibit 20) and annual fixed costs (see Exhibit 18) computed for throughputs of one, two and three million tons per year, and are presented in Exhibits 21, 22 and 23. Figures 7-42 illustrate the relationships between unit costs per ton and throughput.

As indicated by the data in Exhibits 21, 22 and 23, with few exceptions, the system with the lowest total cost per ton is the horizontal travel crane. The chassis system, because of the large amount of land area required and the relatively high investment in equipment, has the highest total cost per ton.

More importantly, the figures indicate that for similar life spans and tonnage throughputs, the systems using land fill costs required

FIGURE 7
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY

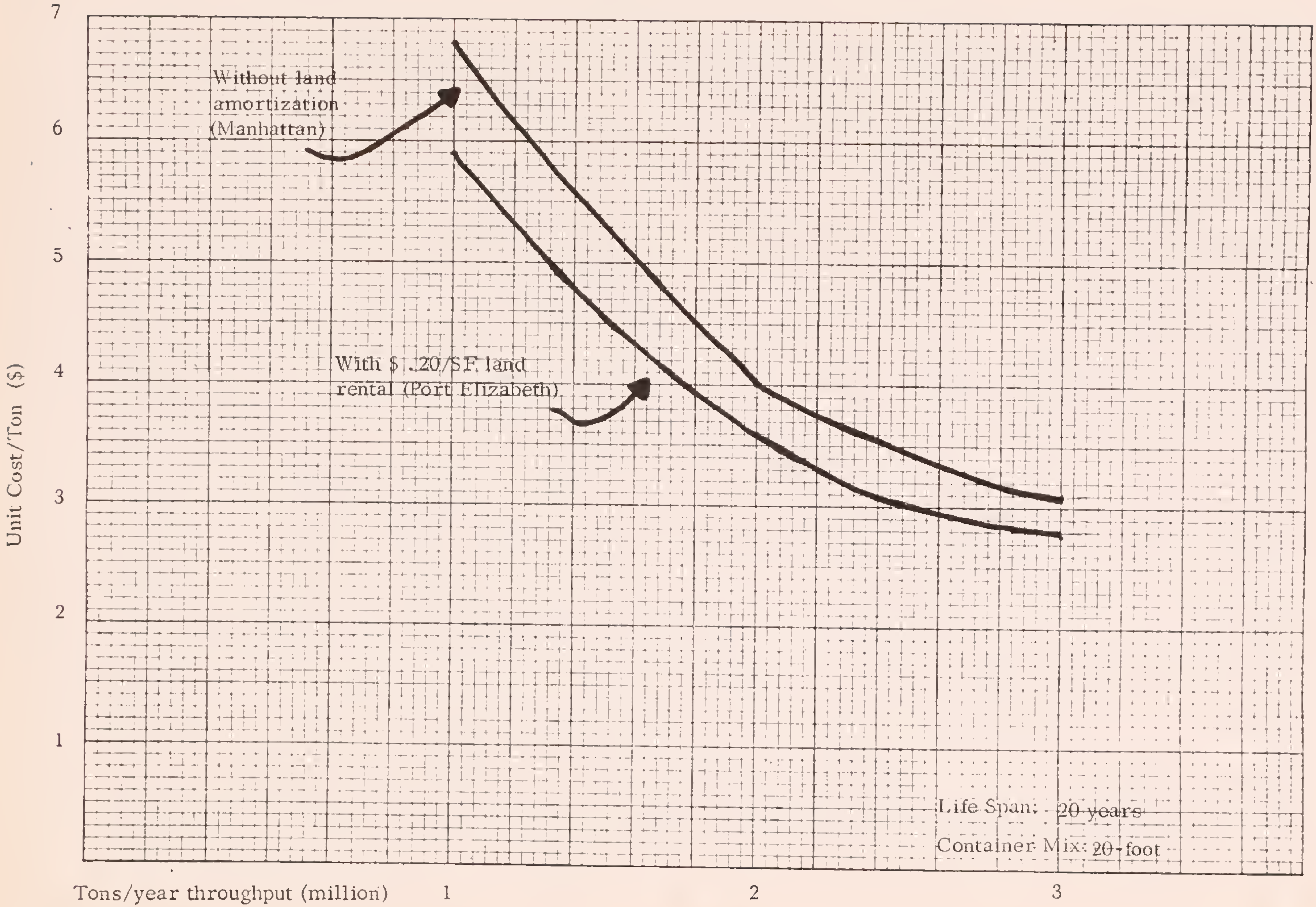


FIGURE 8
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY

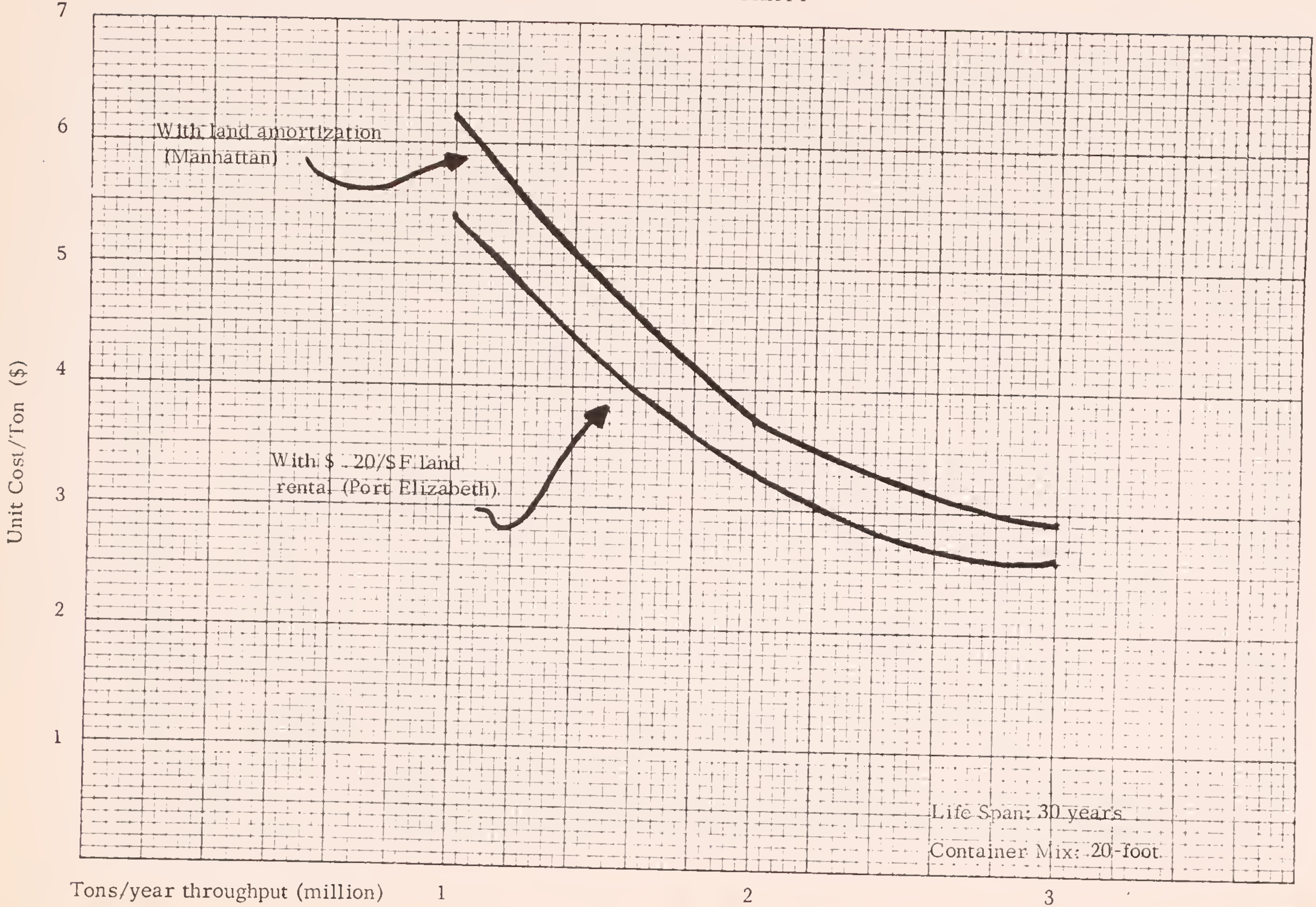


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FIGURE 9
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY

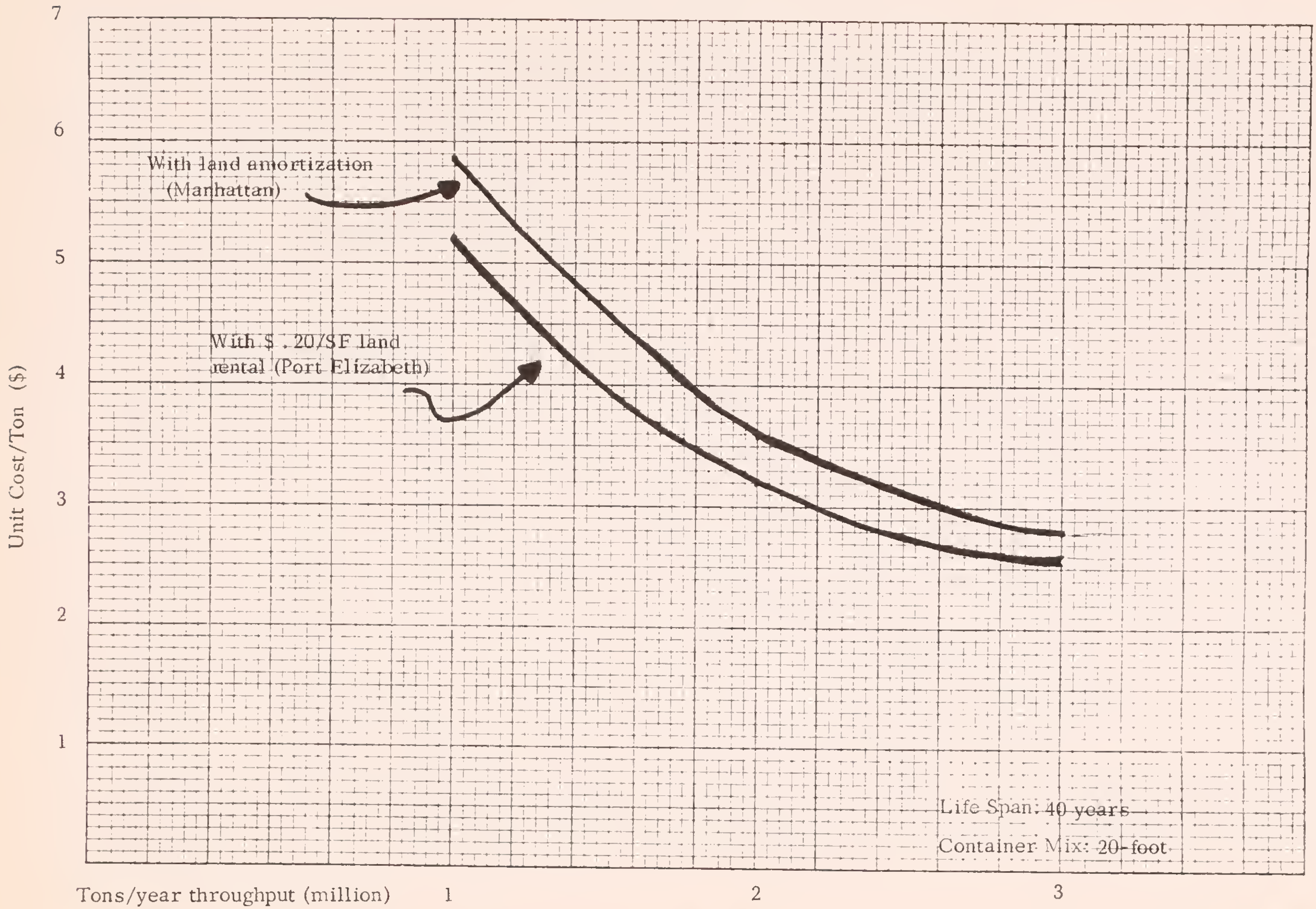

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FIGURE 10
UNIT COSTS VERSUS TONS/YEAR
CHASSIS

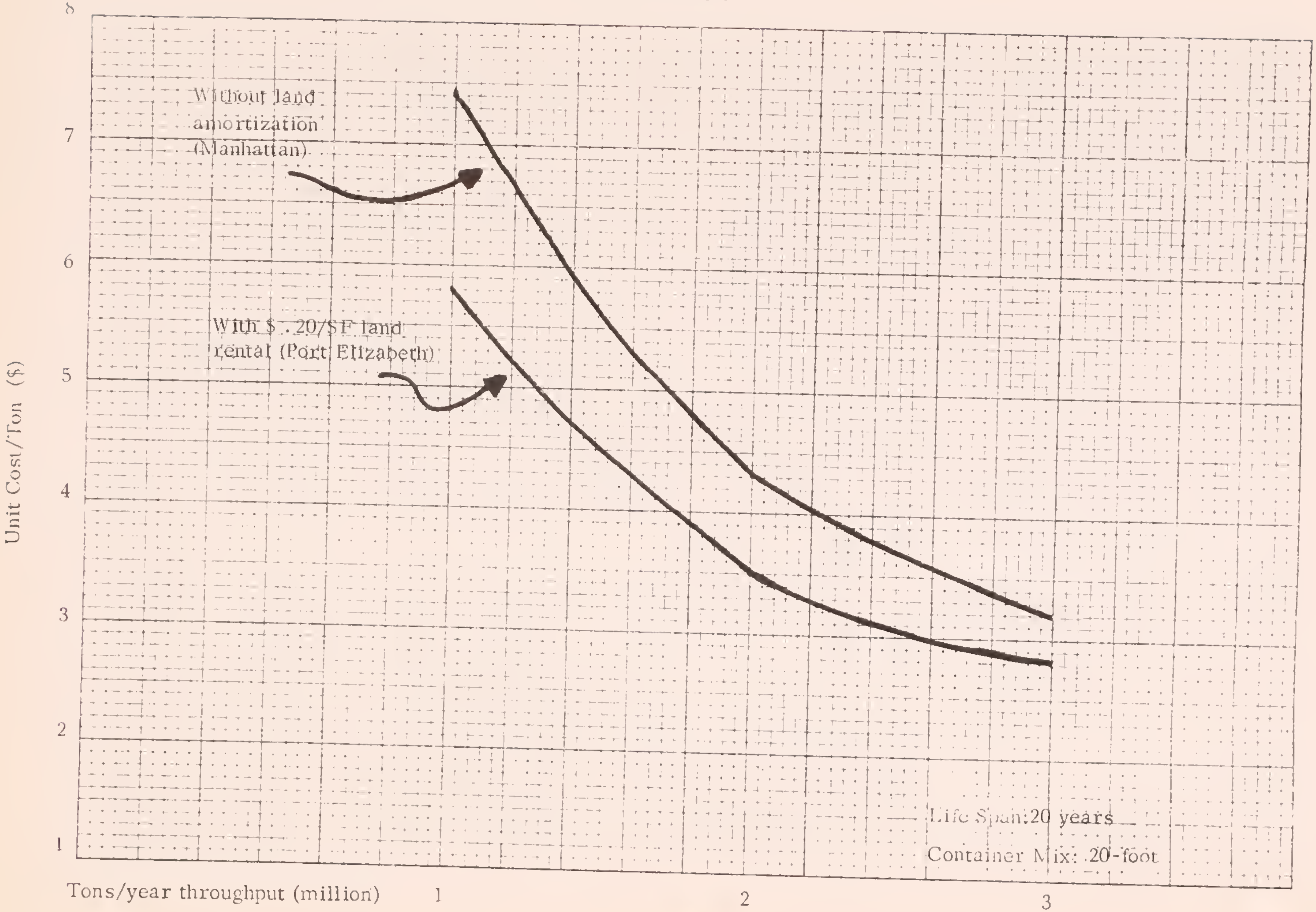

FIGURE 11
UNIT COSTS VERSUS TONS/YEAR
CHASSIS

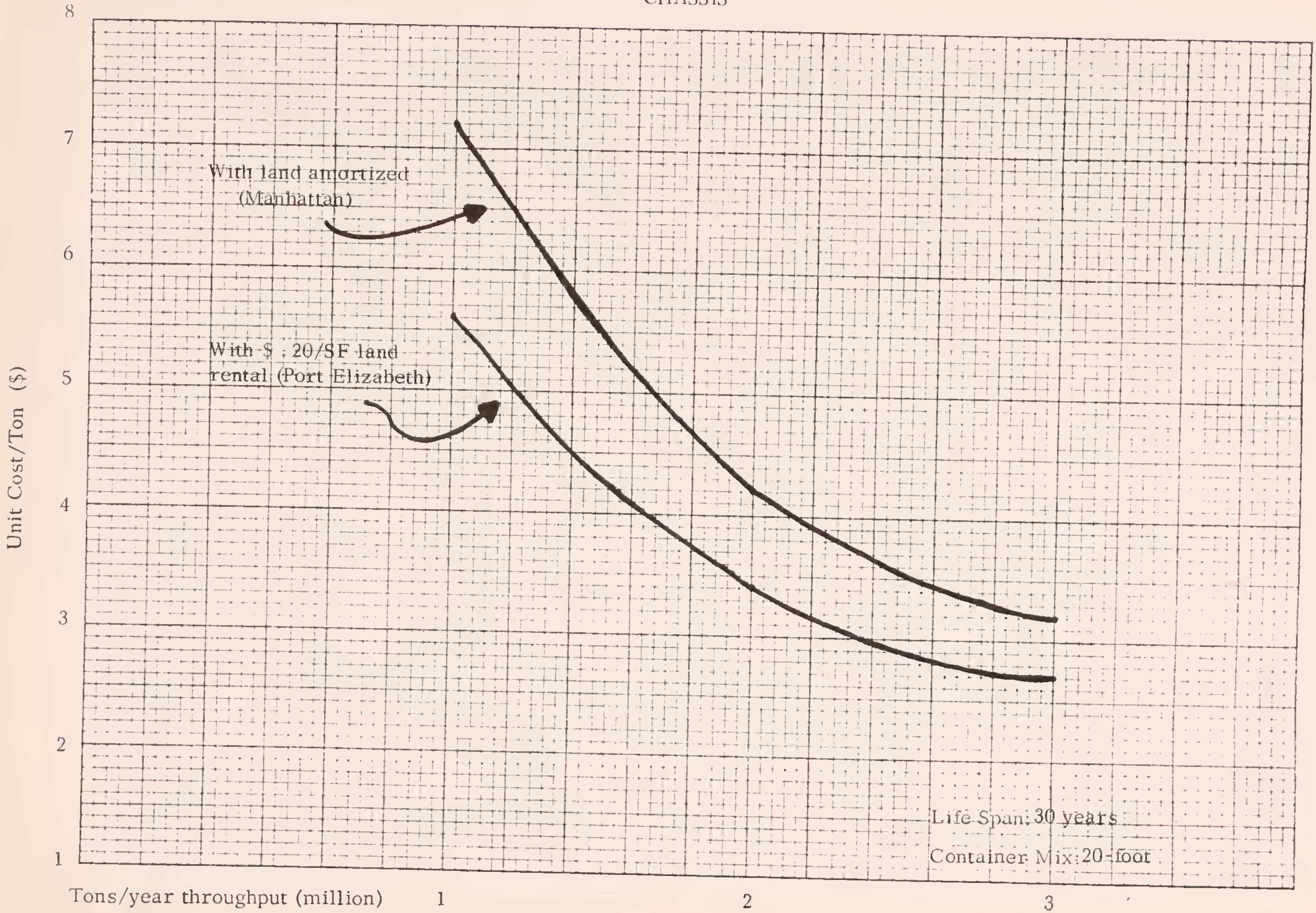

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FIGURE 12
UNIT COSTS VERSUS TONS/YEAR
CHASSIS

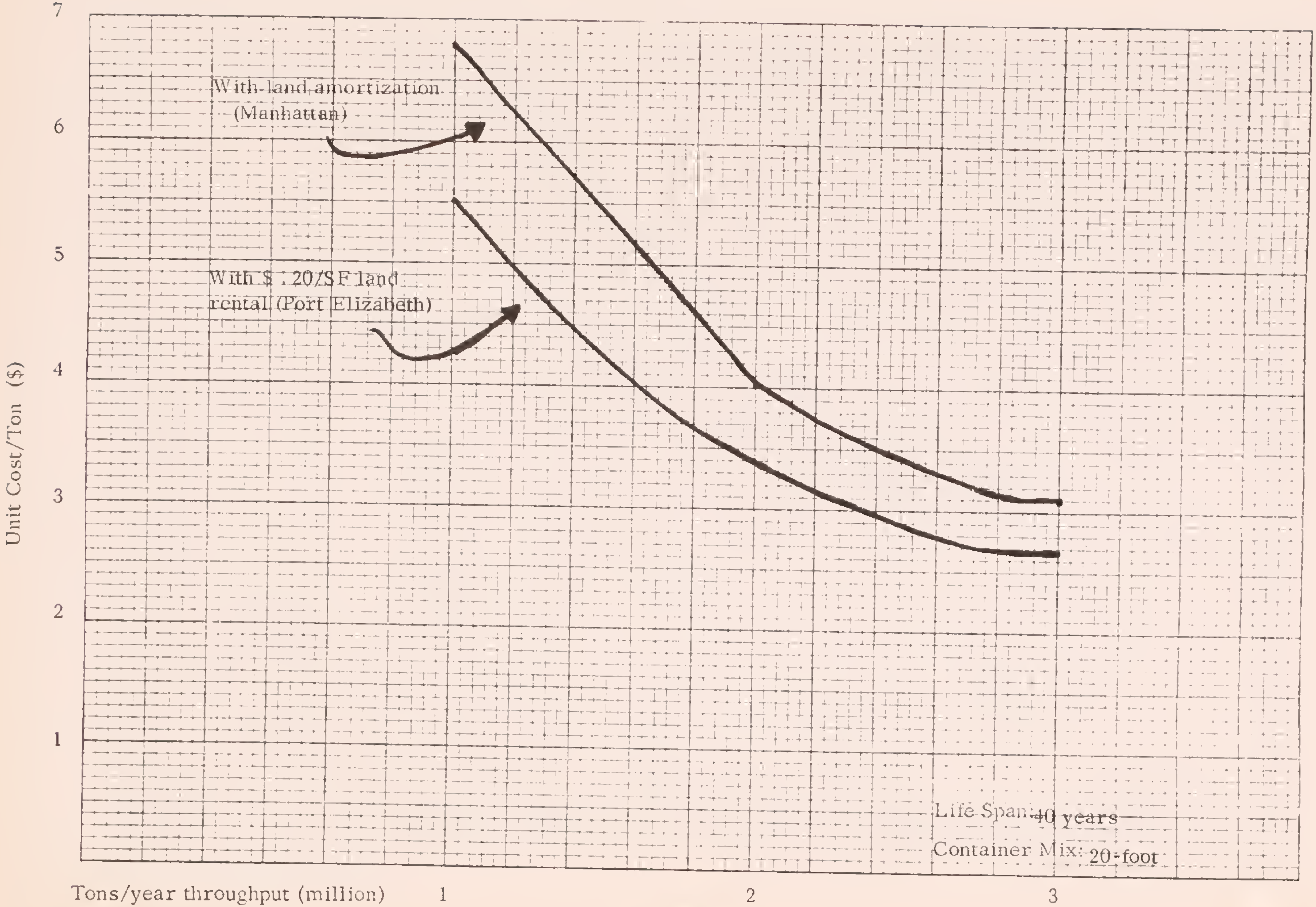

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FIGURE 13
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER

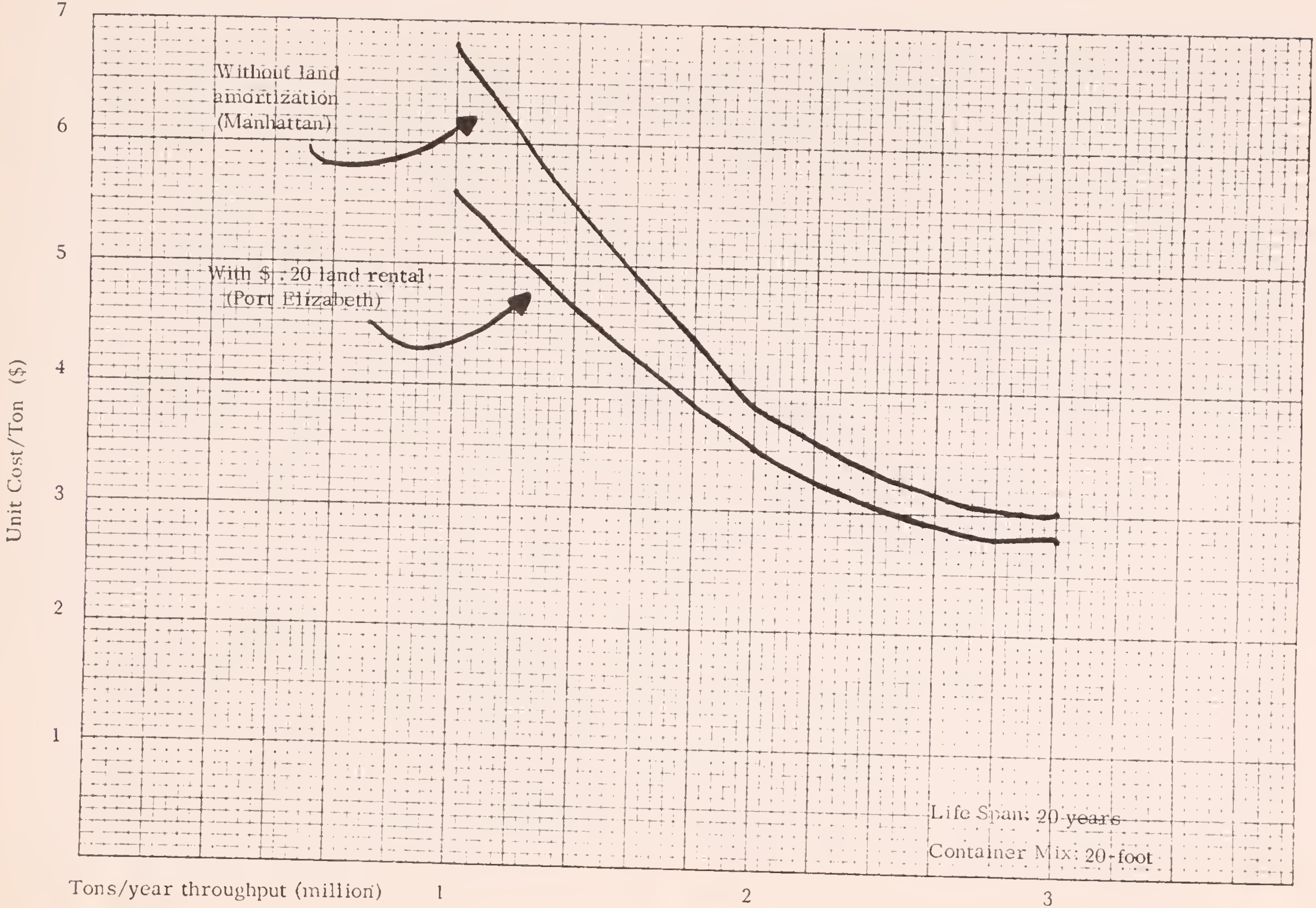

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FIGURE 14
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER

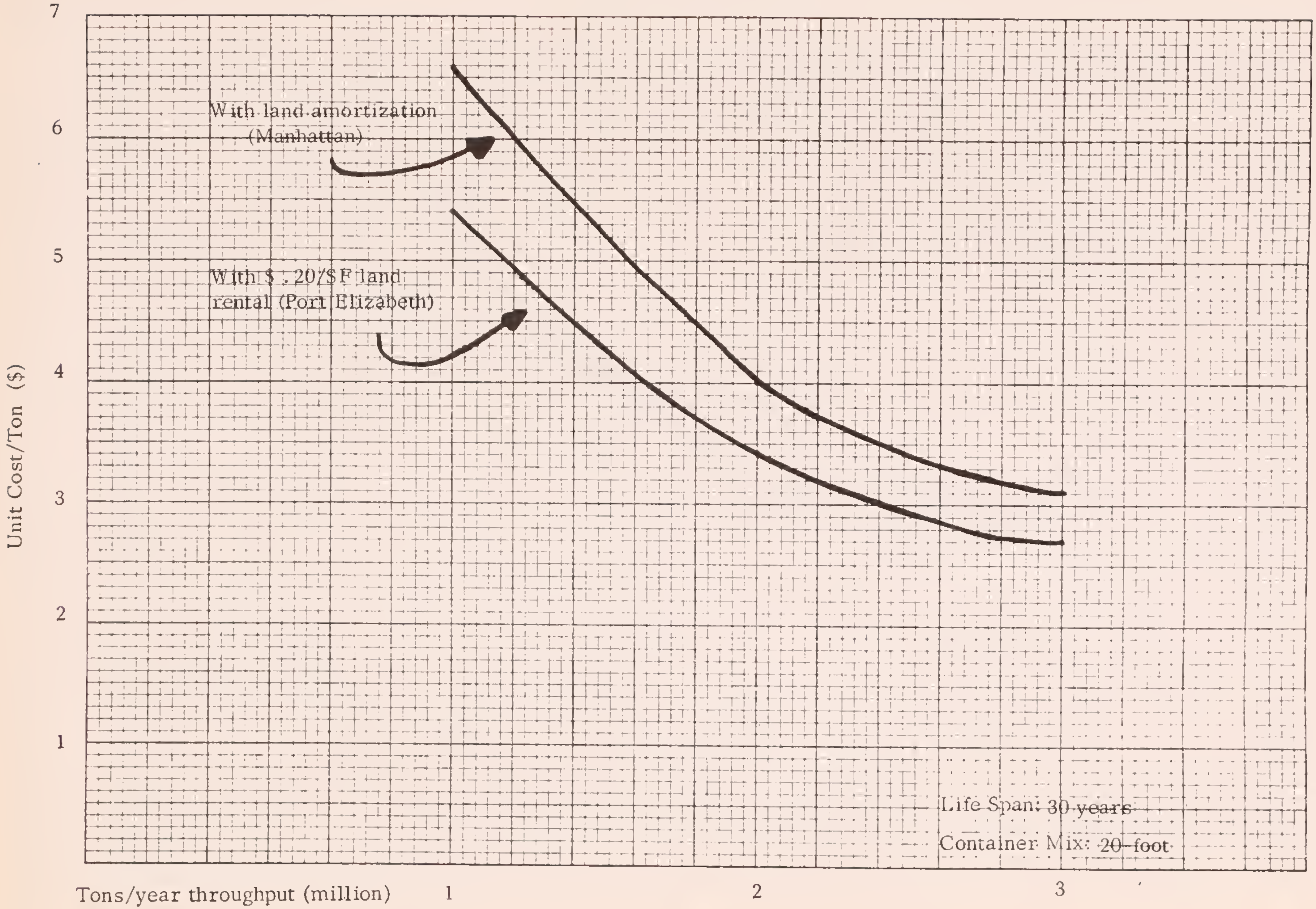

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FIGURE 15
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER

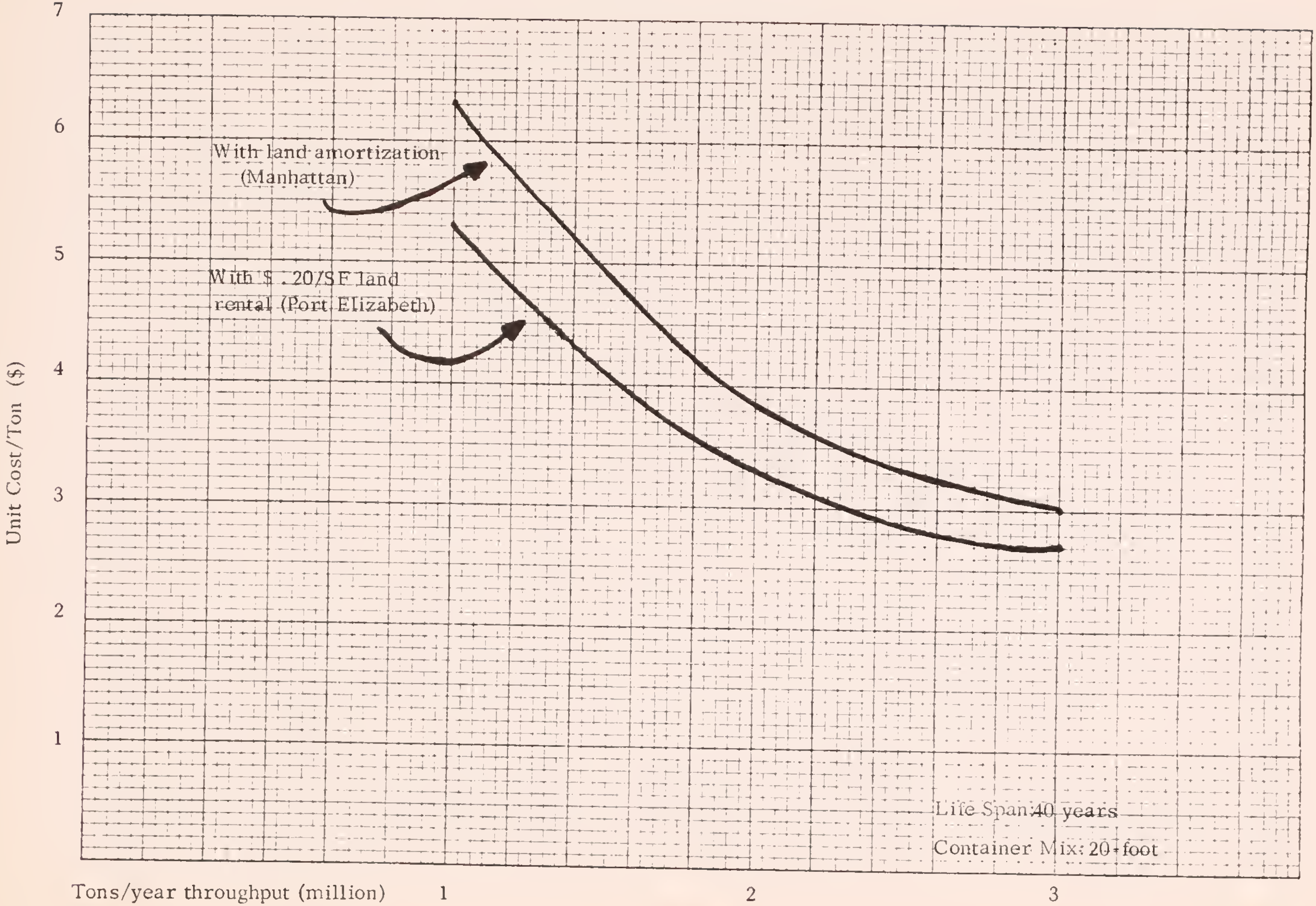
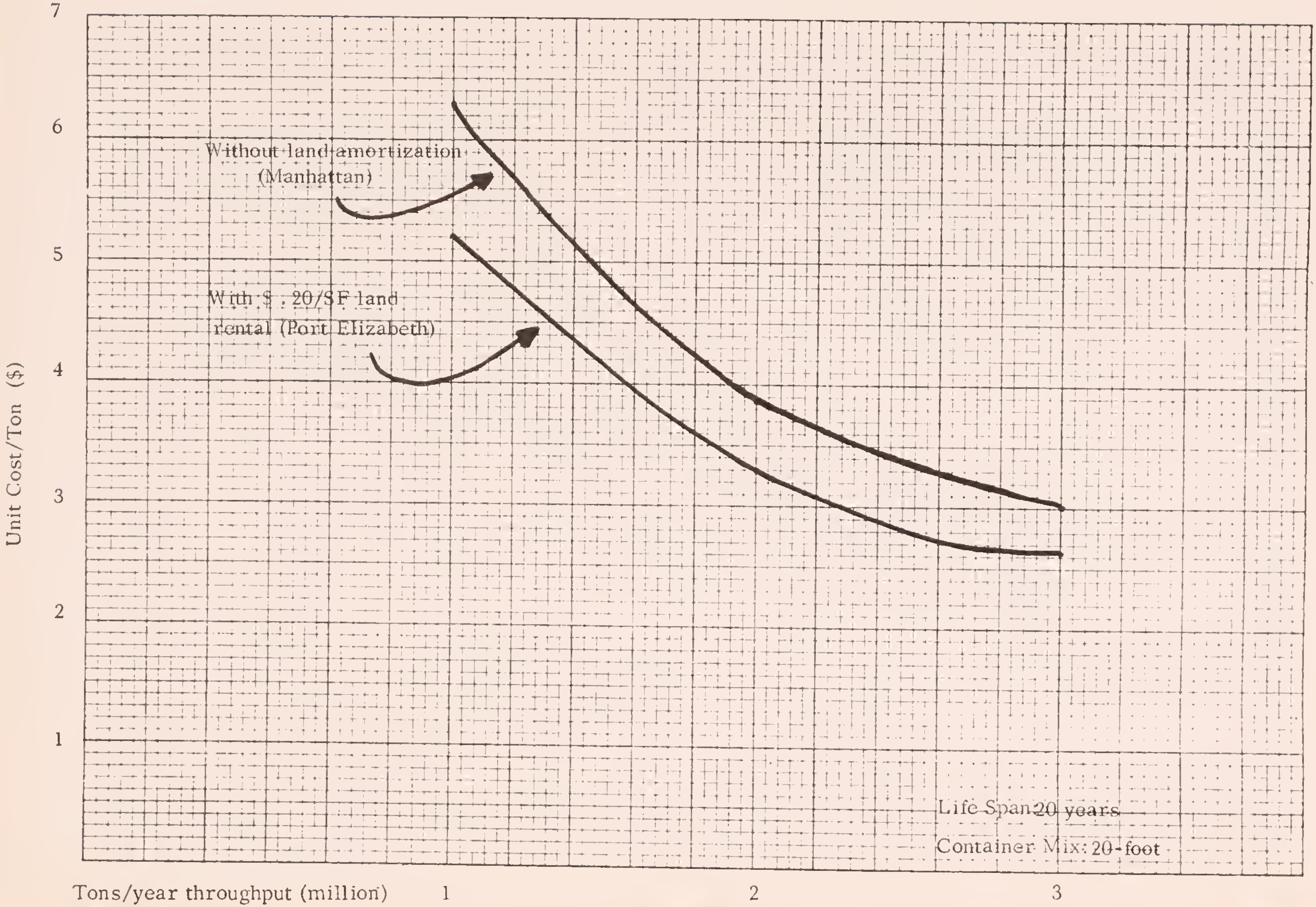
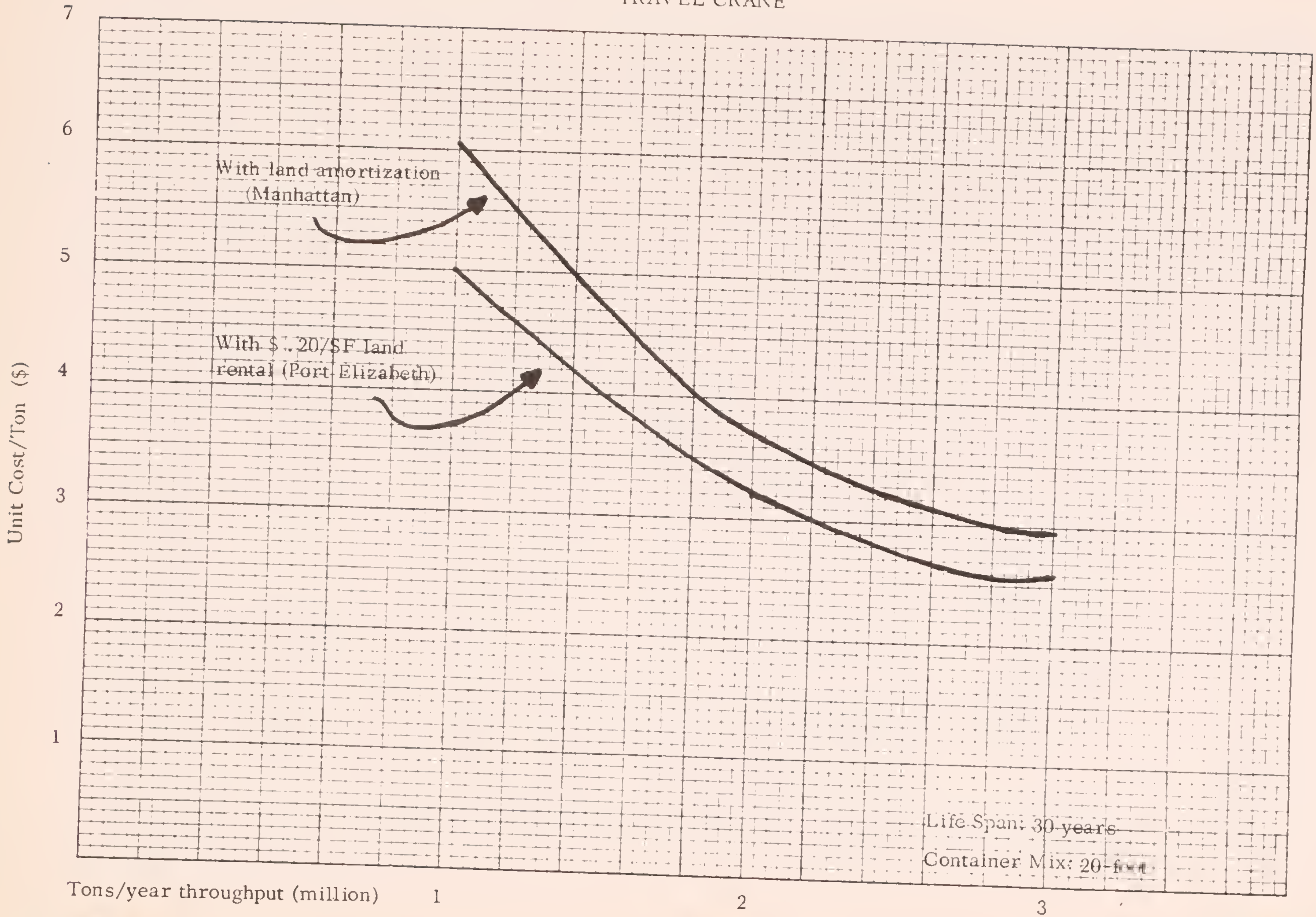


FIGURE 16
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



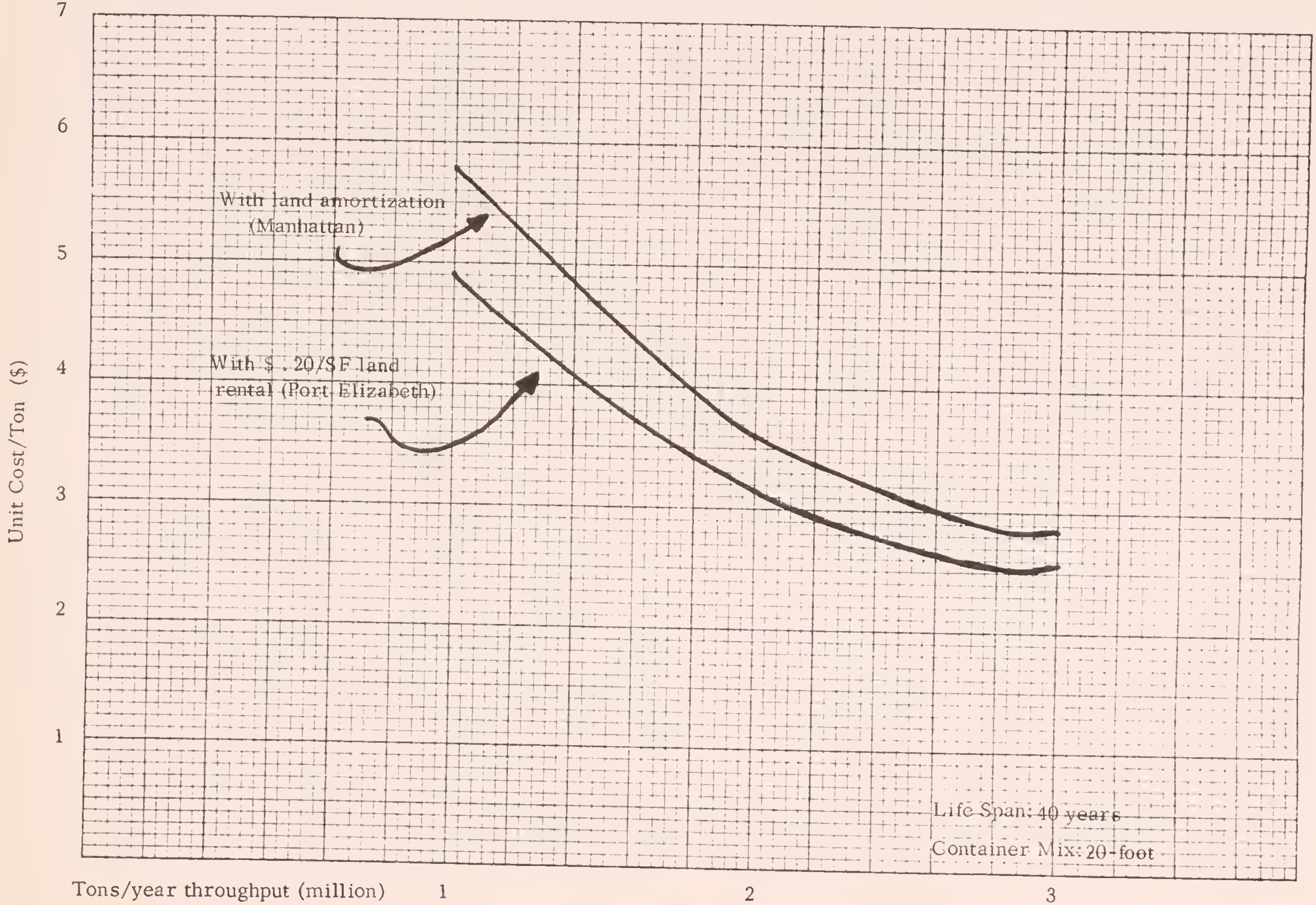
69-a-9

FIGURE 17
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



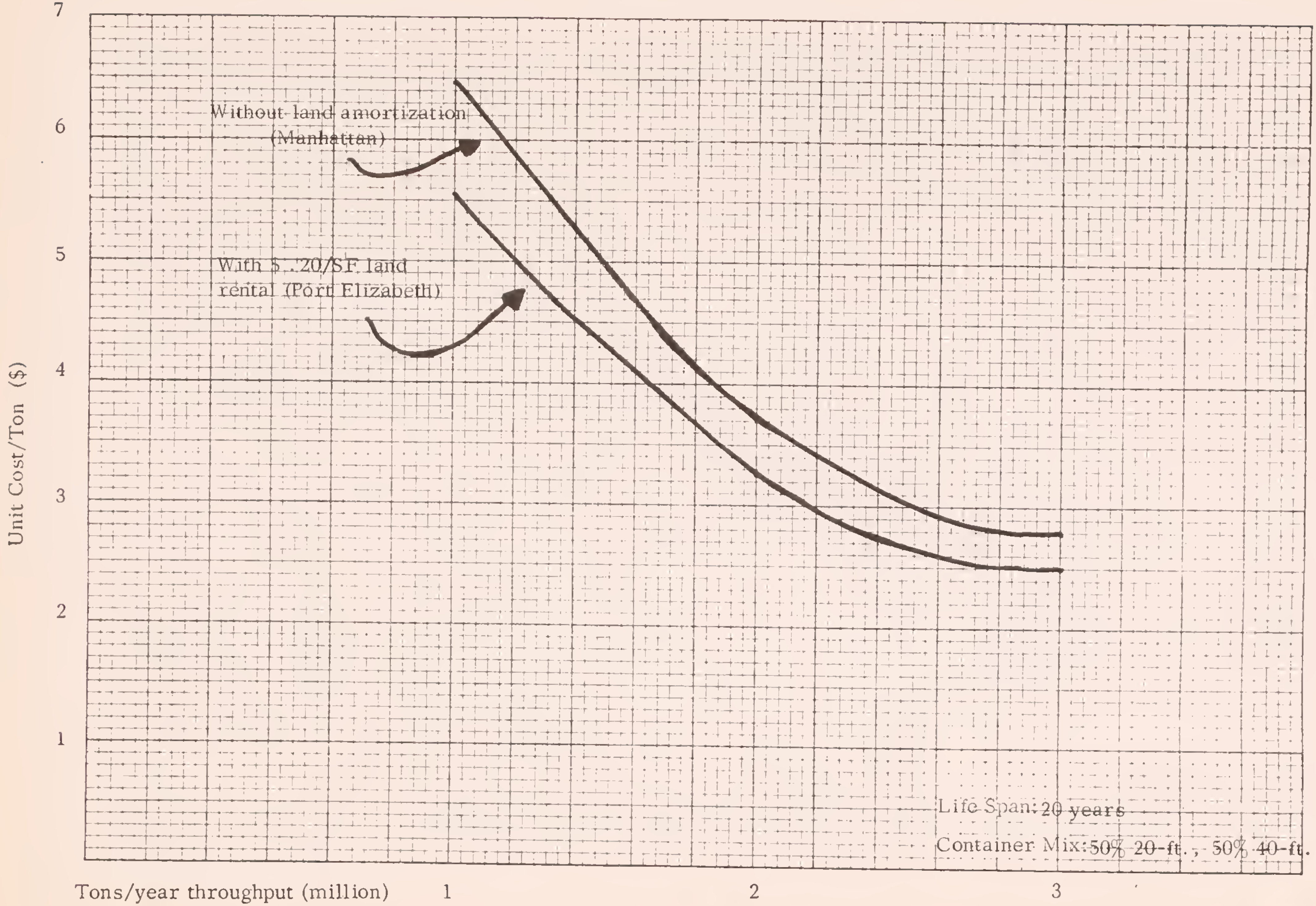
69-a-10

FIGURE 18
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



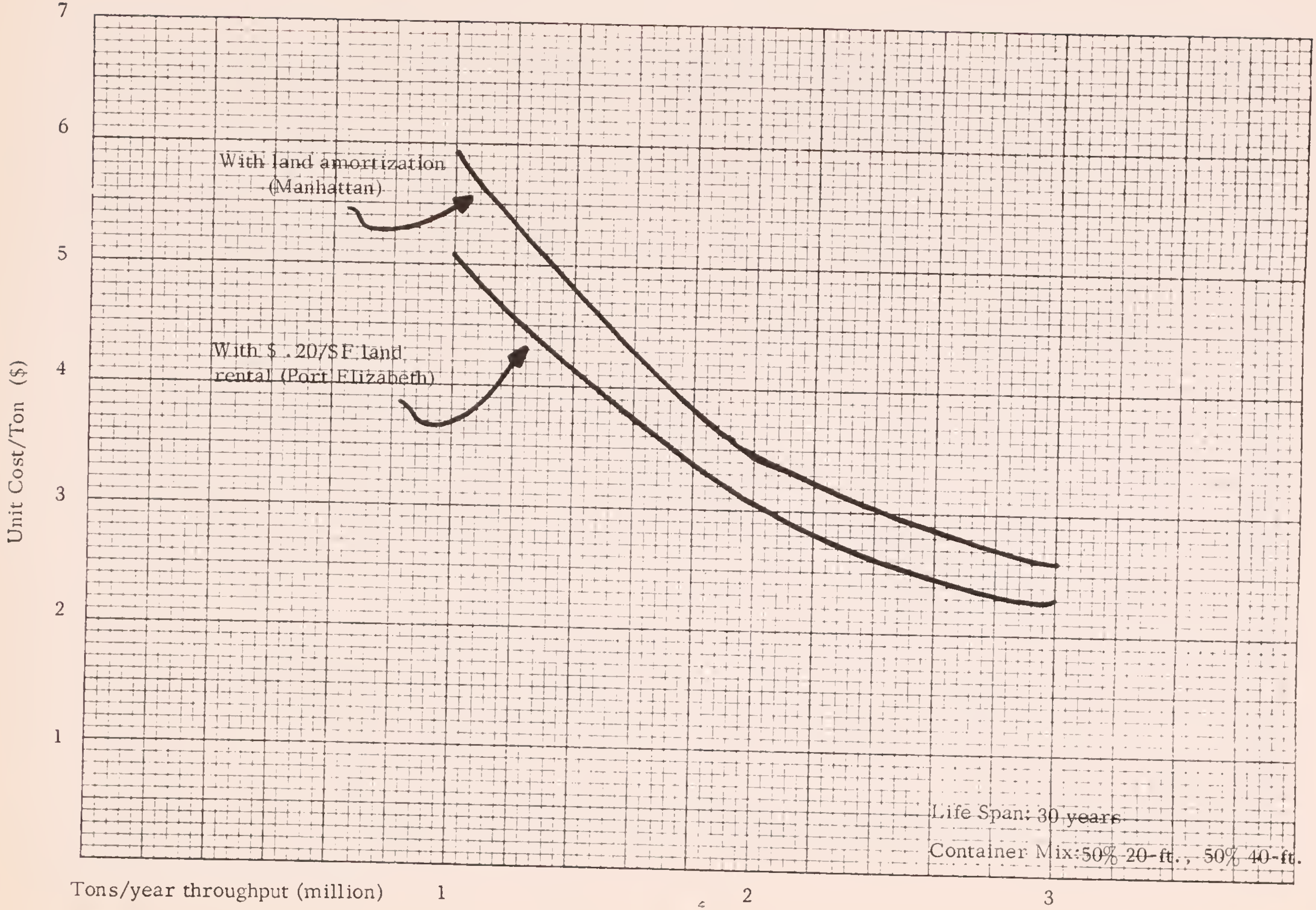
69-a-11

FIGURE 19
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



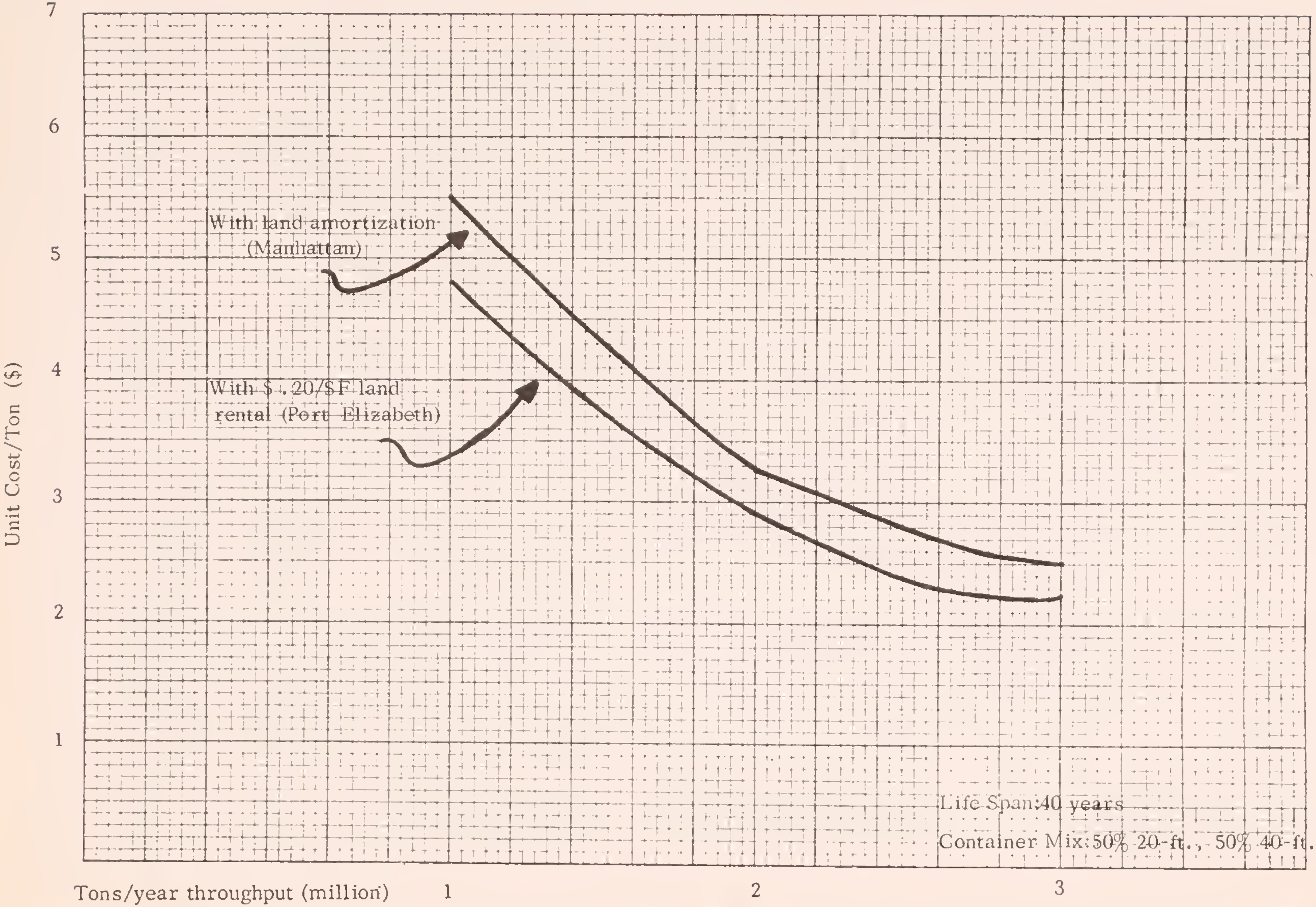
69-a-12

FIGURE 20
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



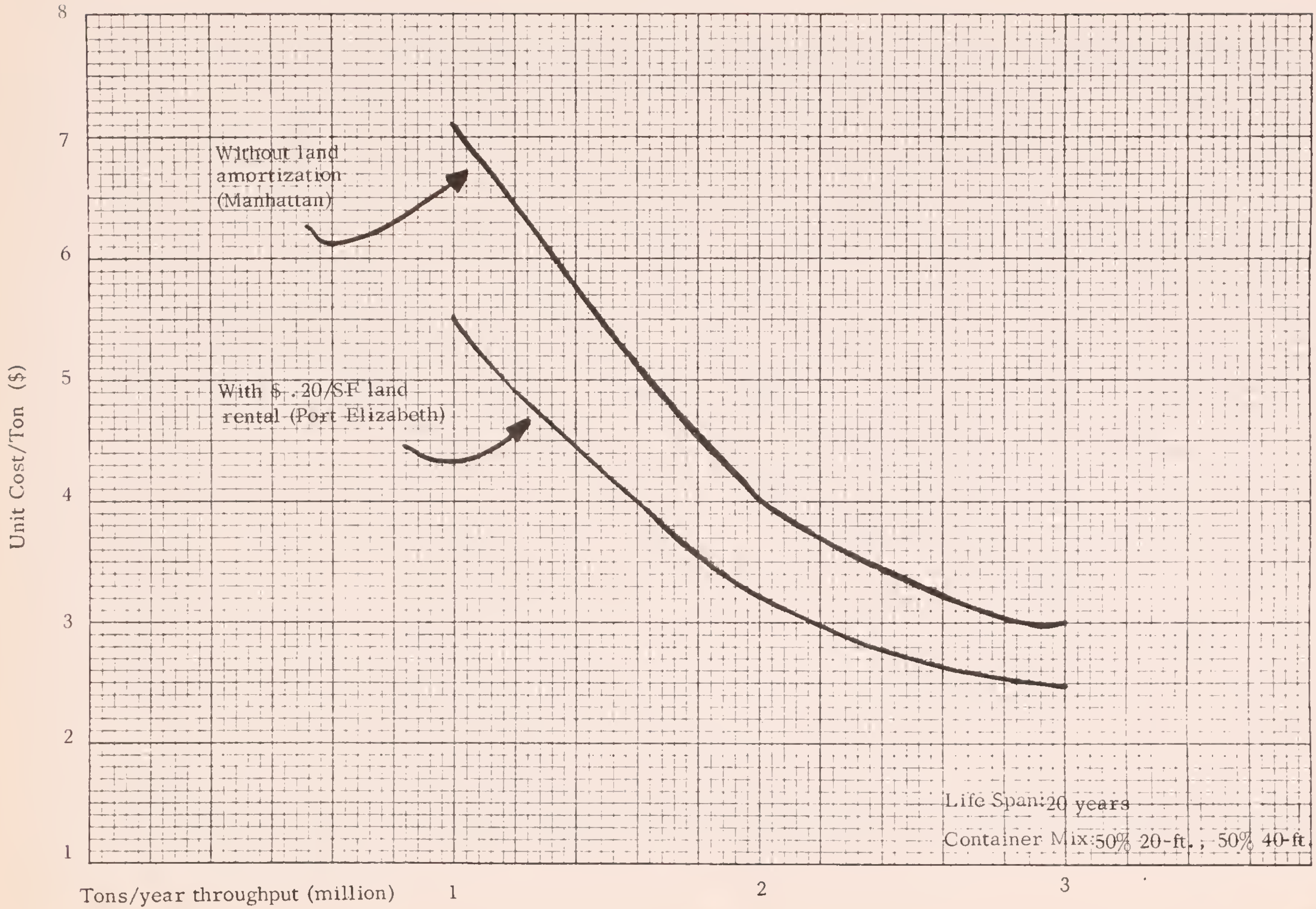
69-a-13

FIGURE 21
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



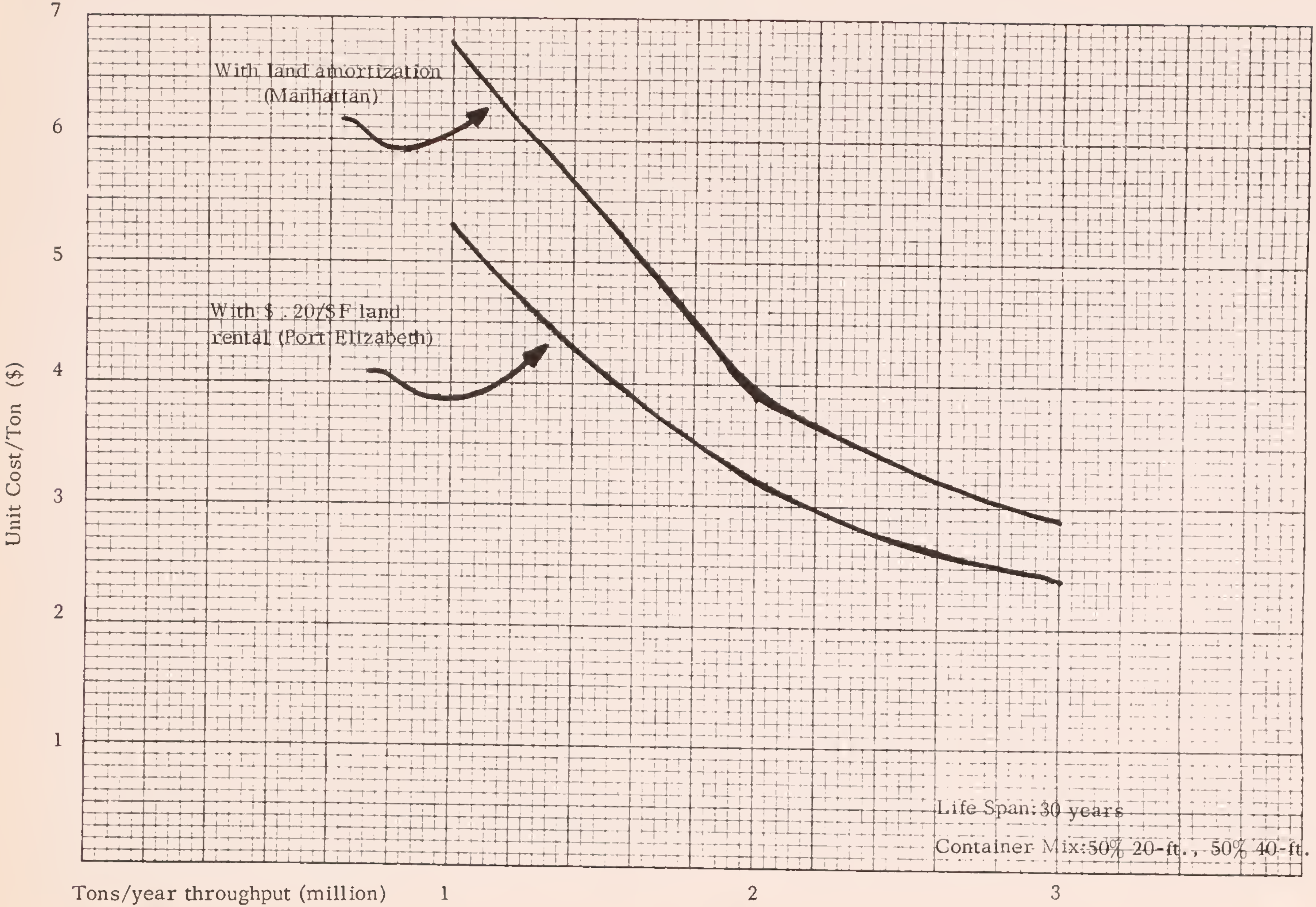
69-a-14

FIGURE 22
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



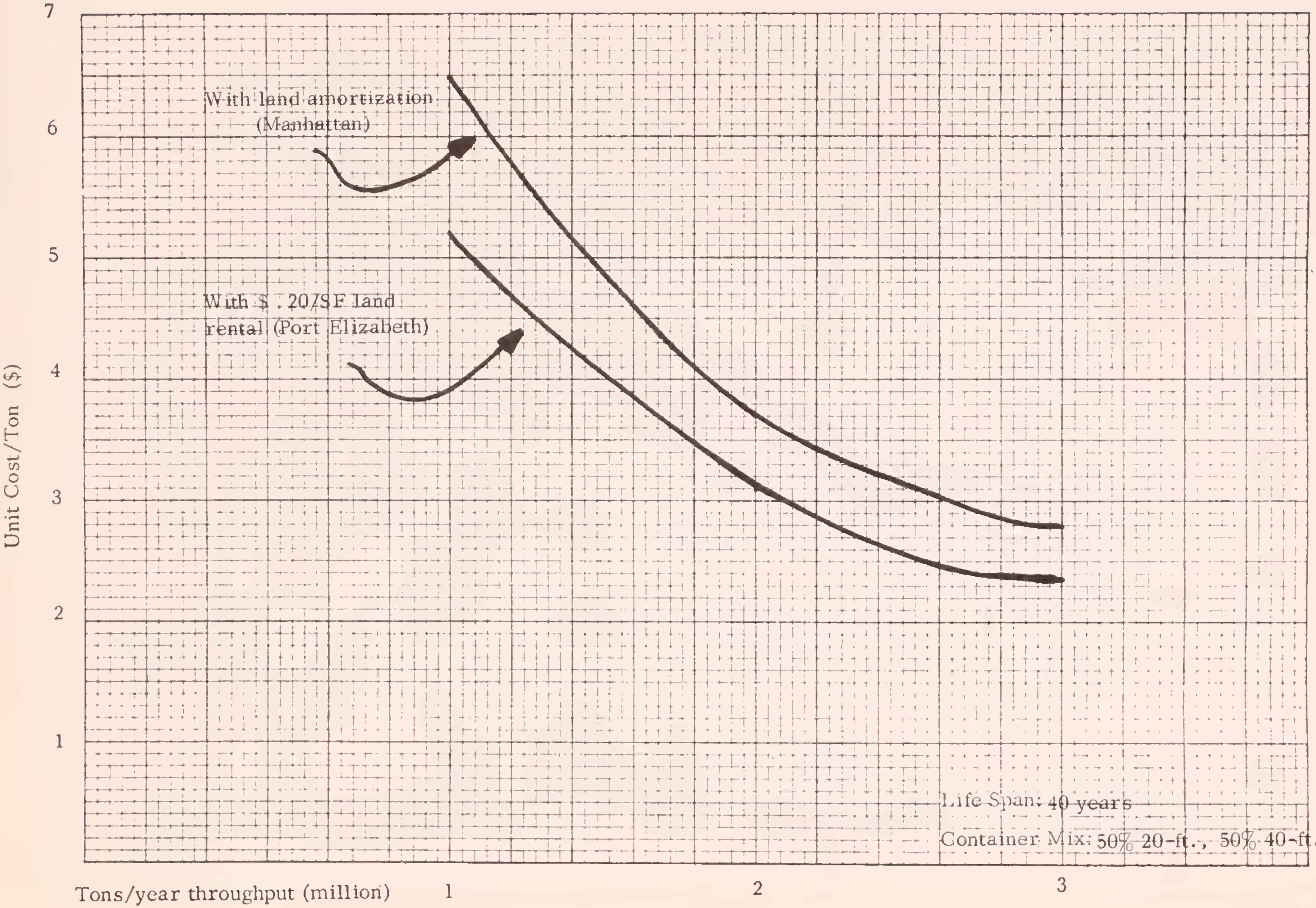
69-a-15

FIGURE 23
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



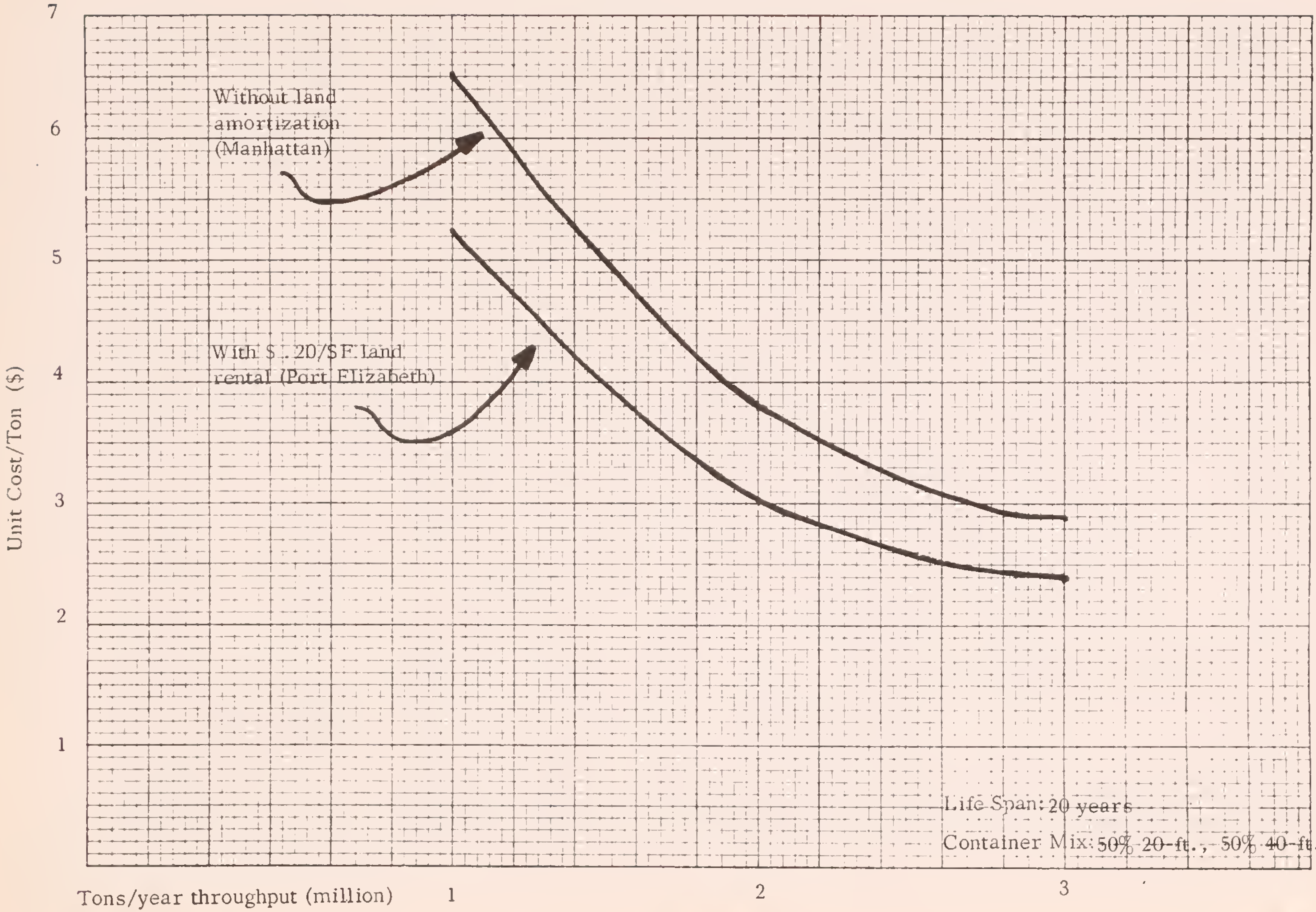
69-a-16

FIGURE 24
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



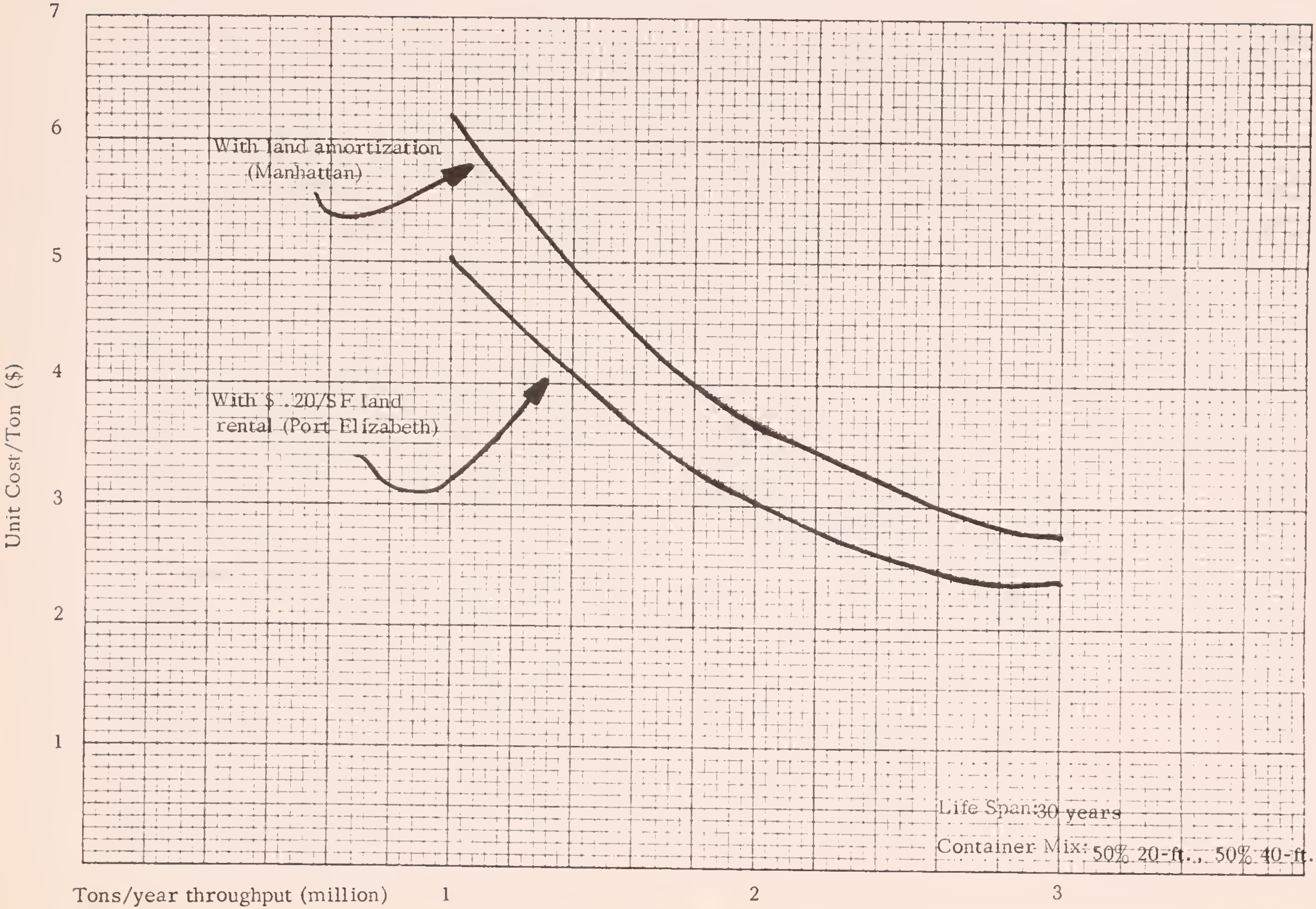
69-a-17

FIGURE 25
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



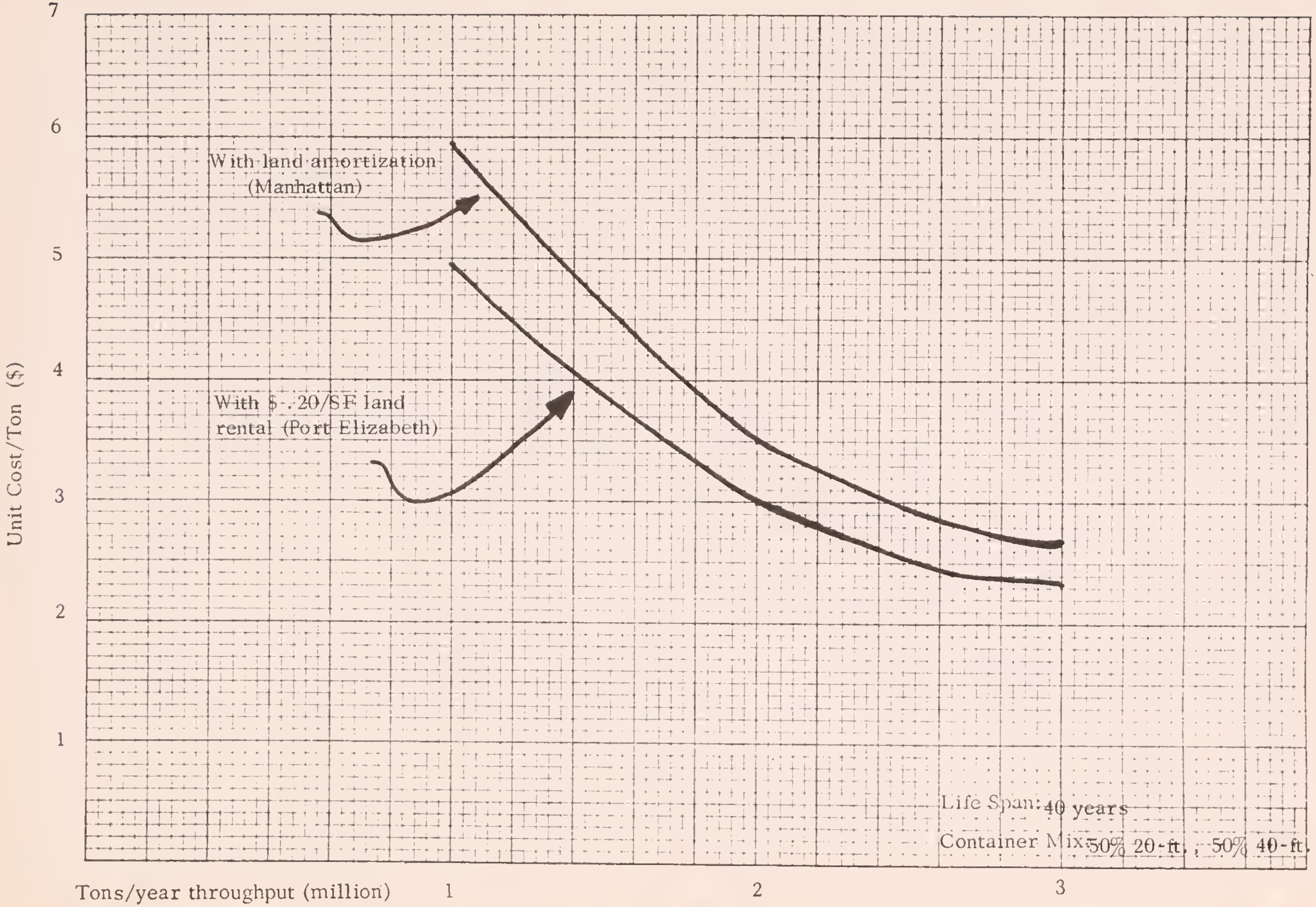
69-a-18

FIGURE 26
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



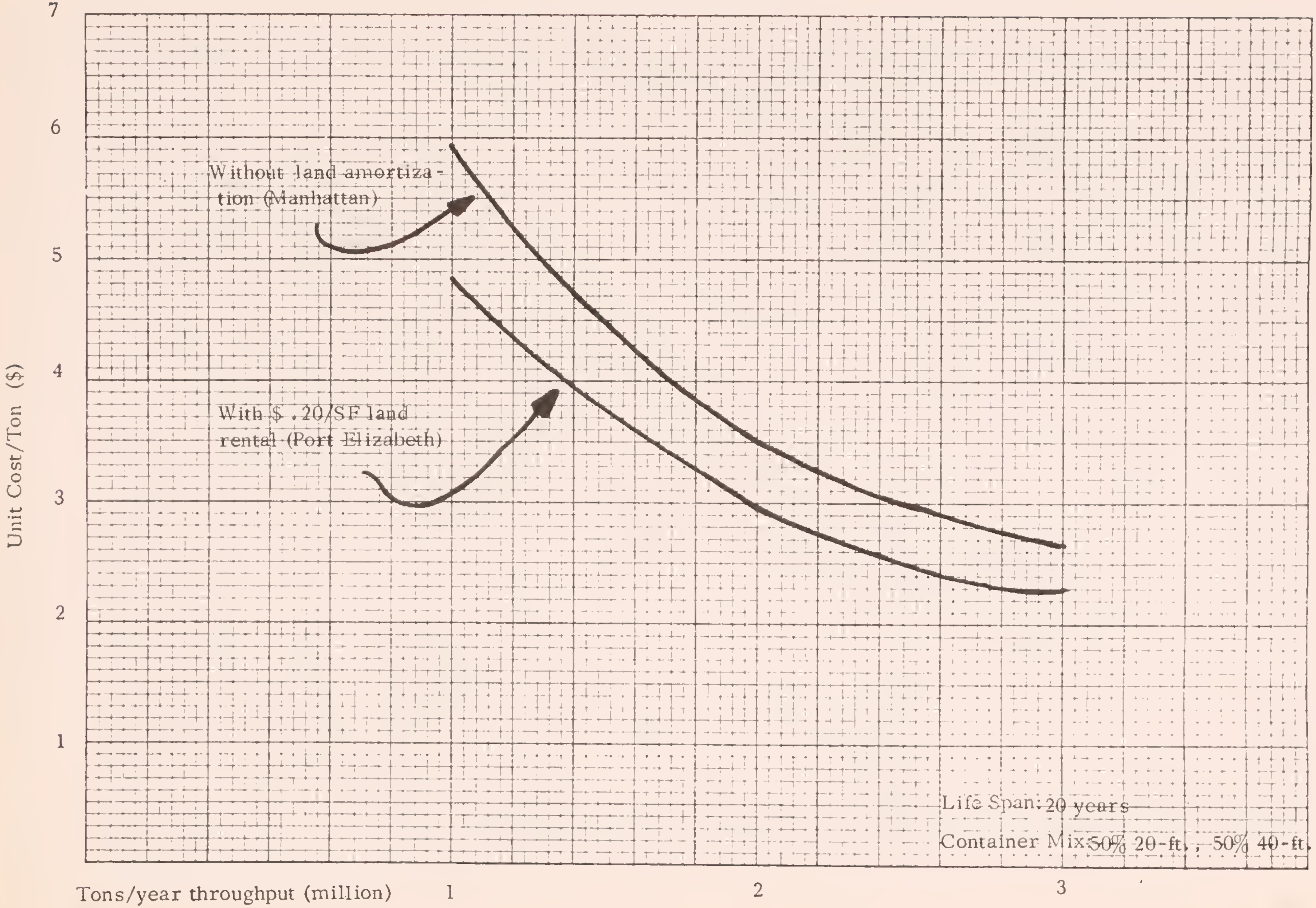
69-a-19

FIGURE 27
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



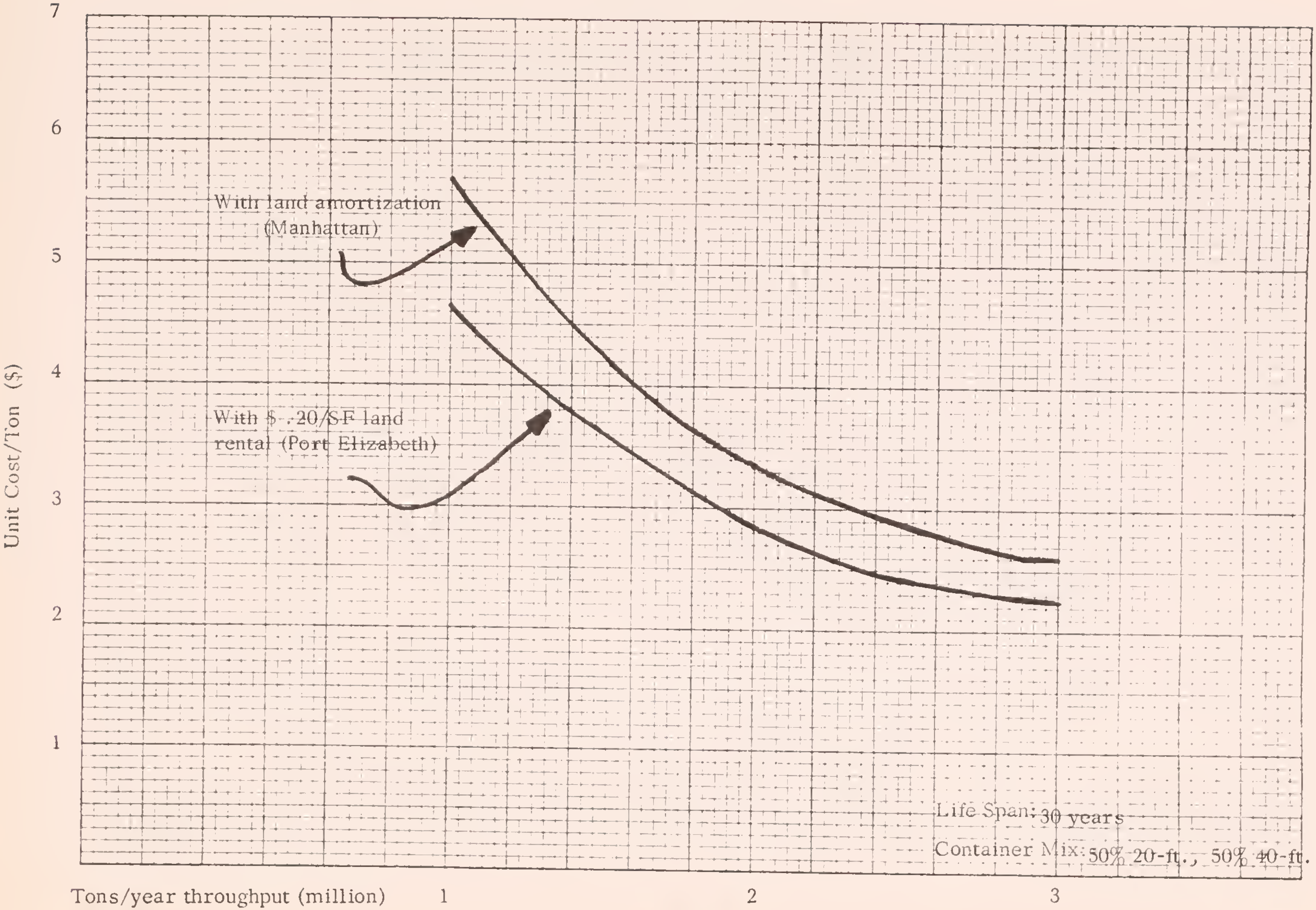
69-a-20

FIGURE 28
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



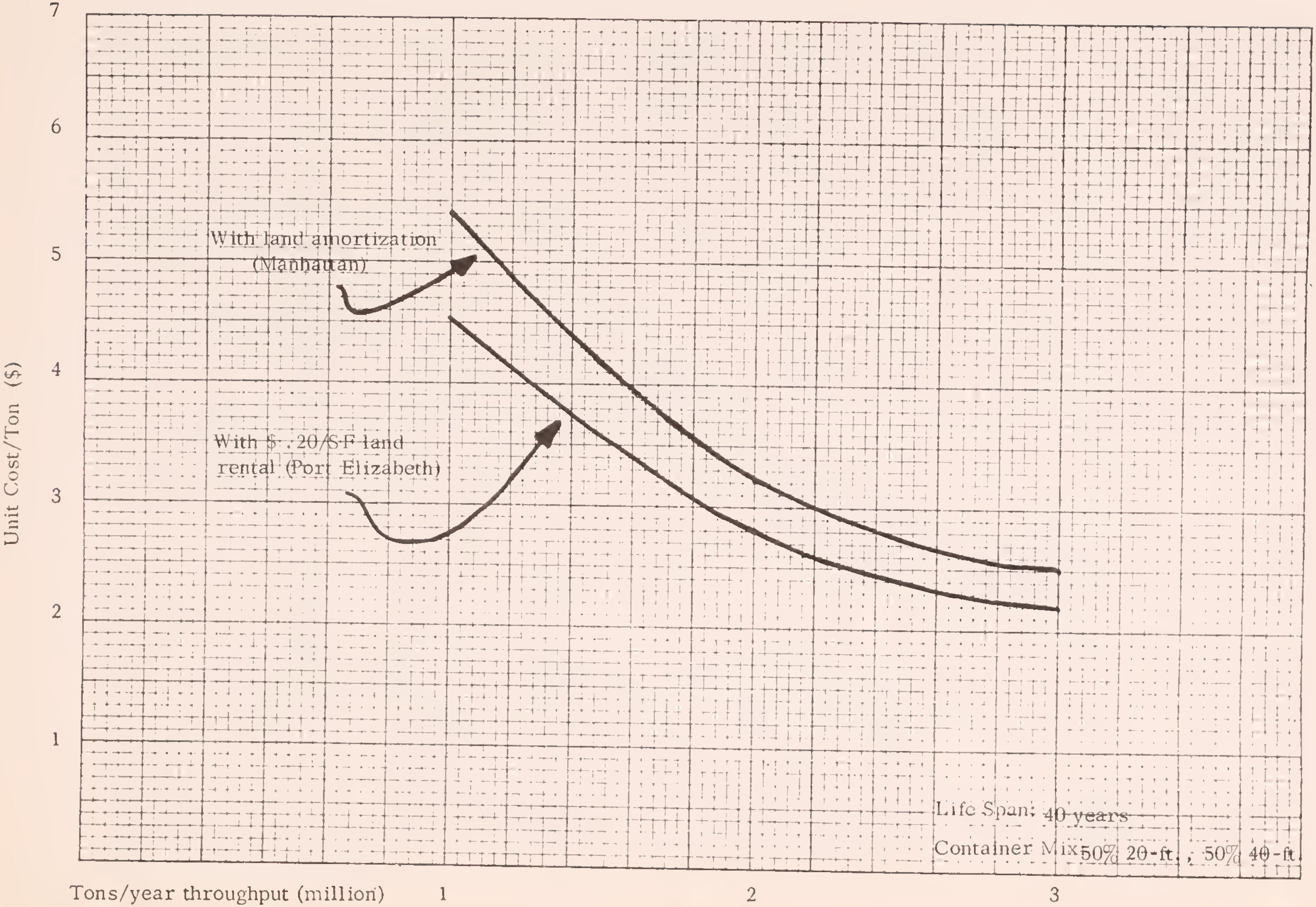
69-a-21

FIGURE 29
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



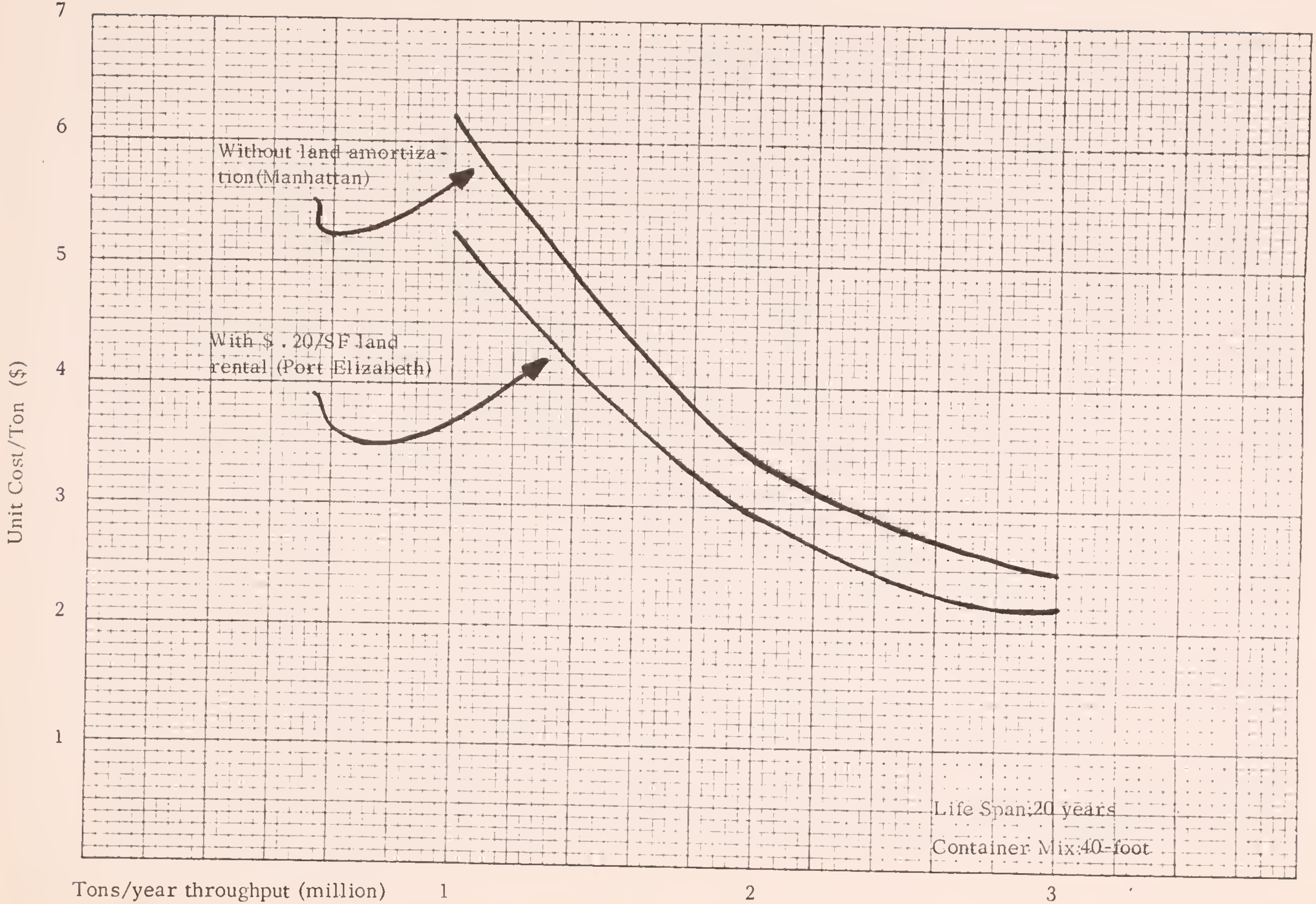
69-a-22

FIGURE 30
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



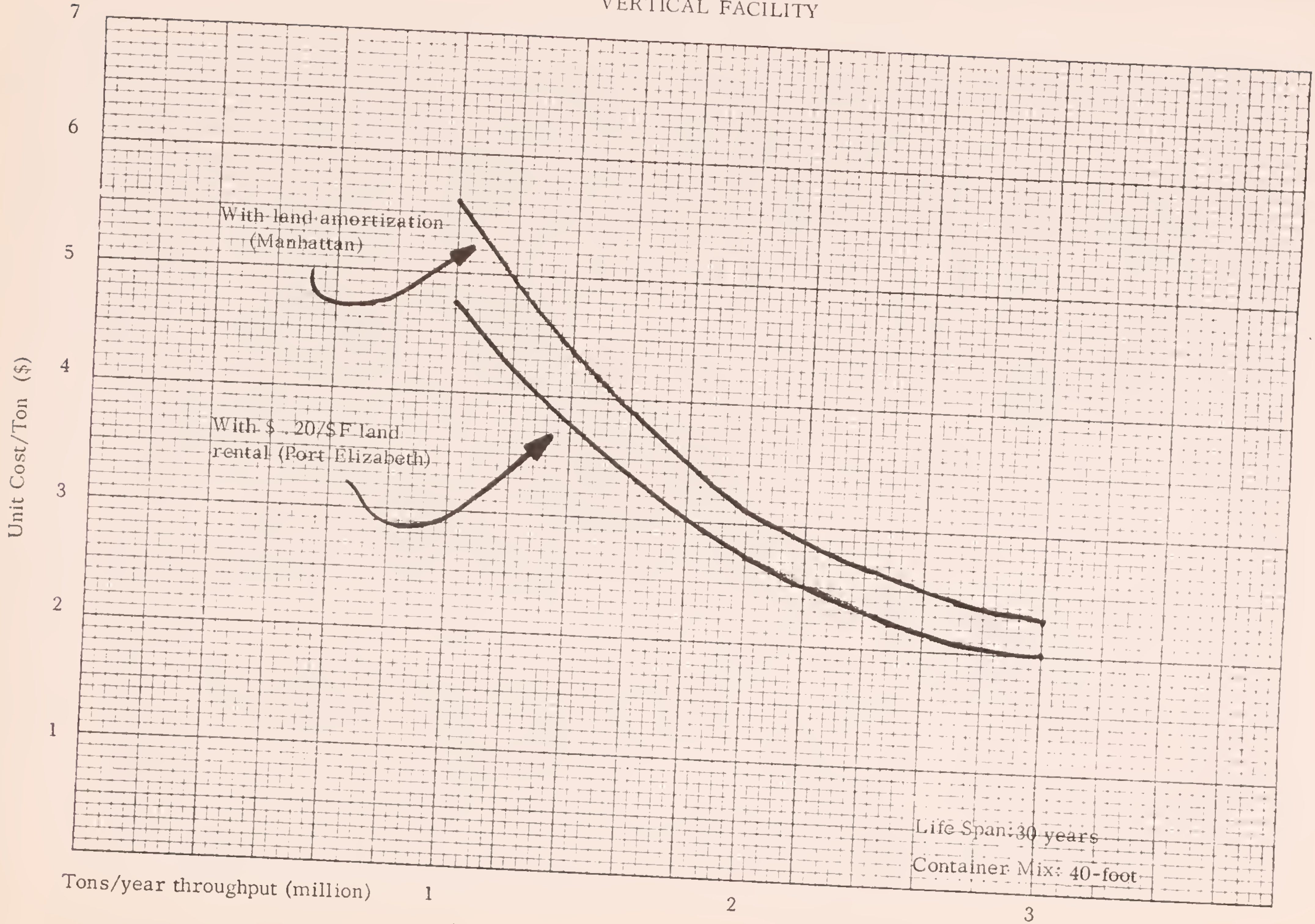
69-a-23

FIGURE 31
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



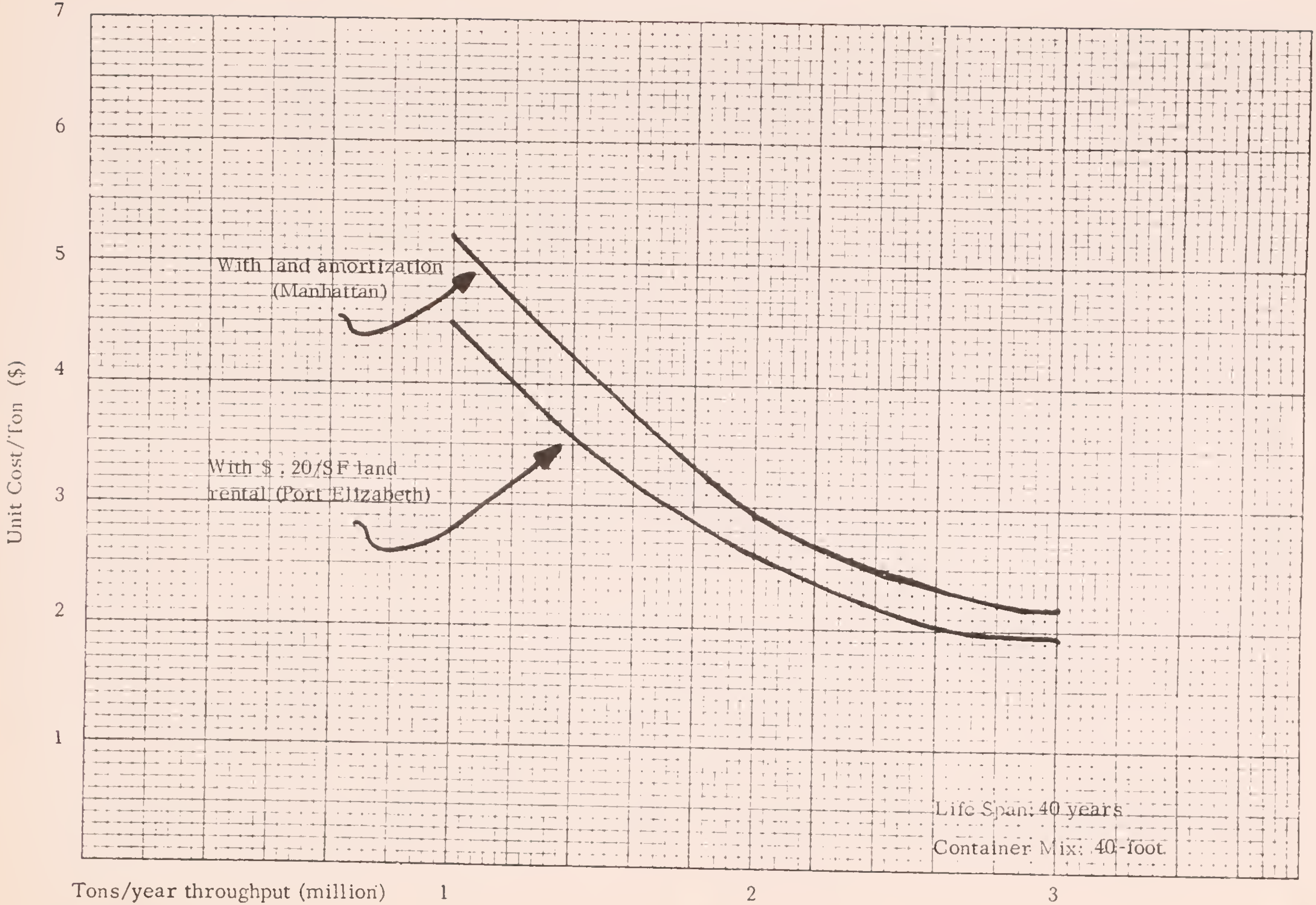
69-a-24

FIGURE 32
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



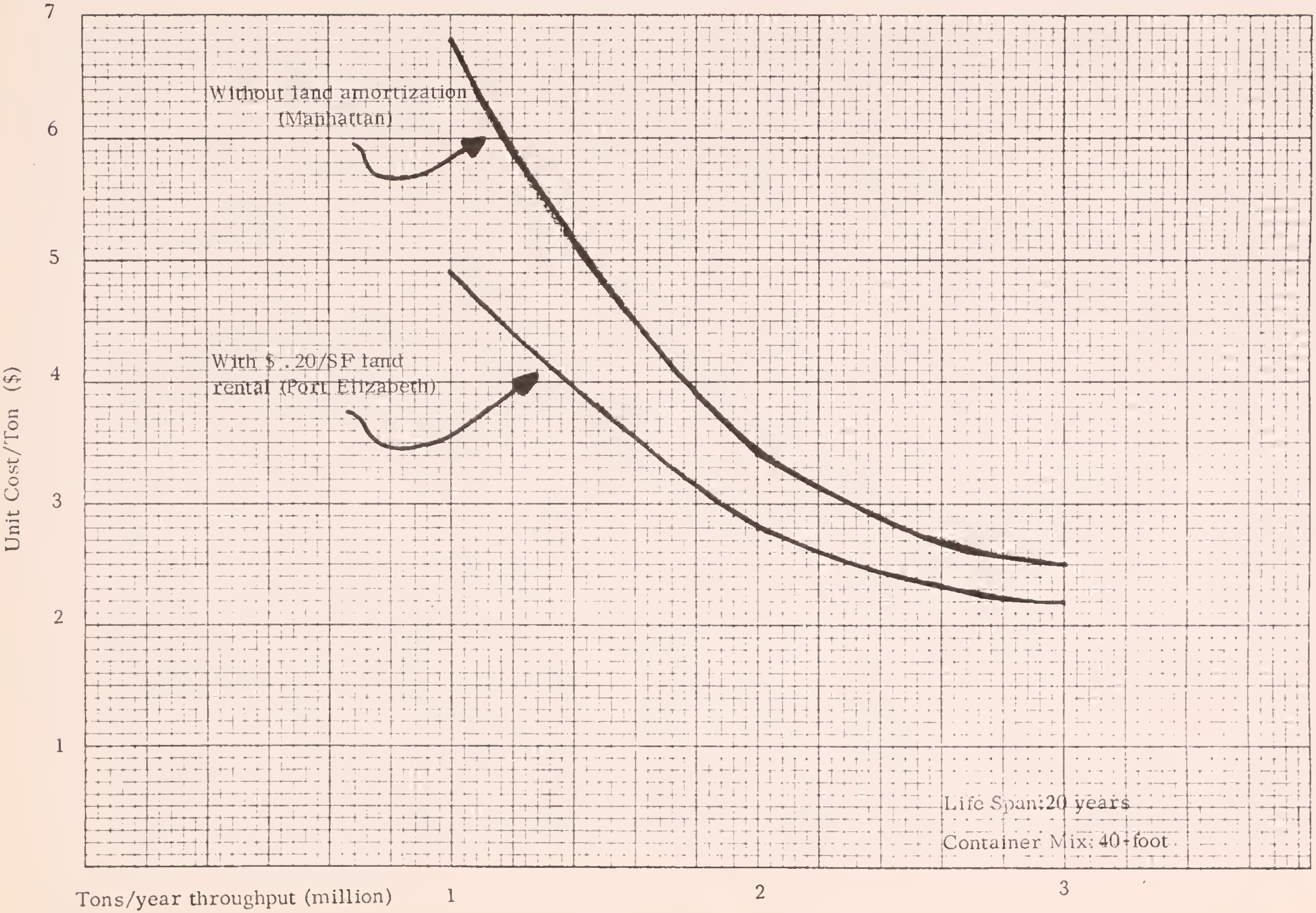
69-a-25

FIGURE 33
UNIT COSTS VERSUS TONS/YEAR
VERTICAL FACILITY



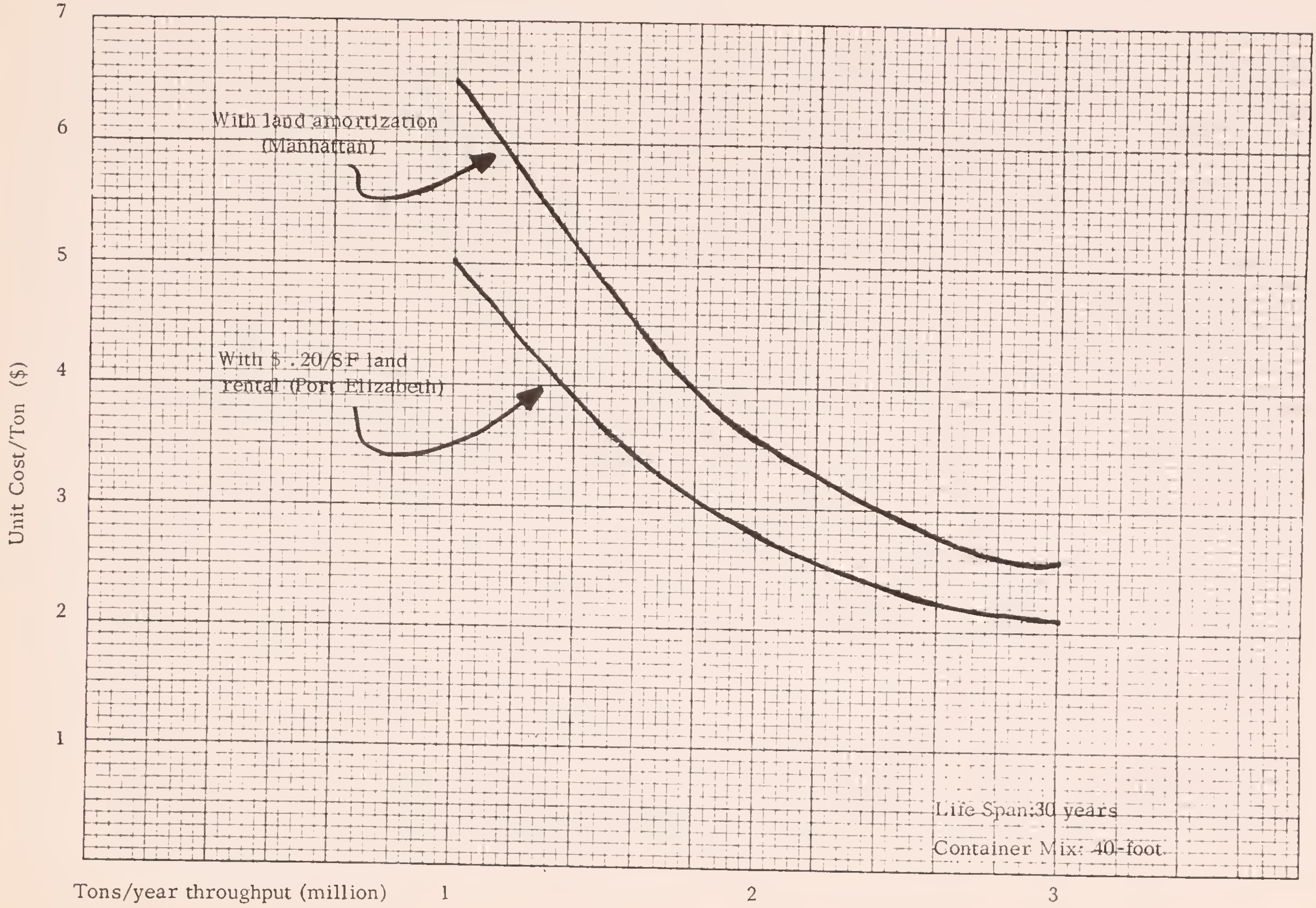
69-a-26

FIGURE 34
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



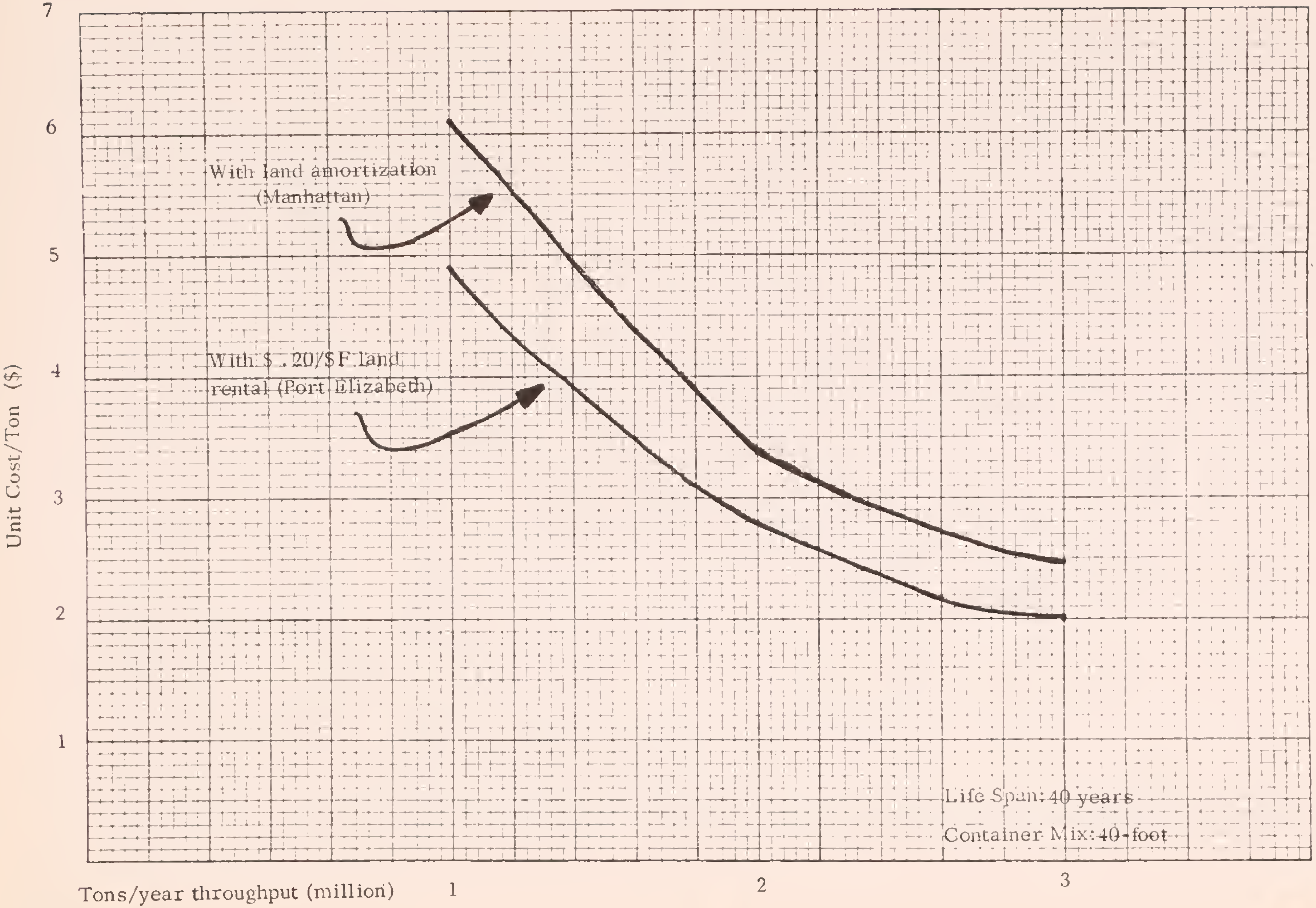
69-a-27

FIGURE 35
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



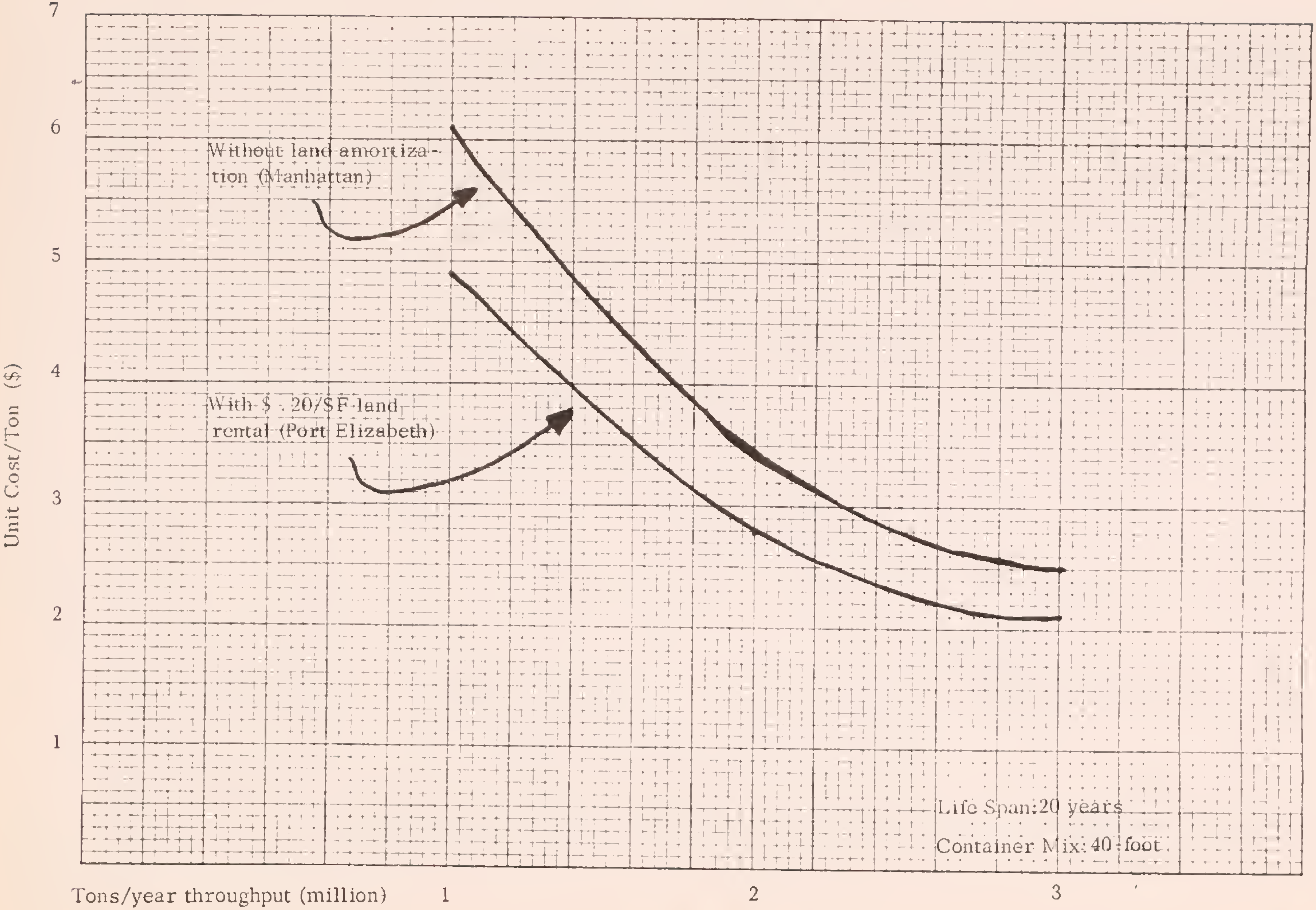
69-a-28

FIGURE 36
UNIT COSTS VERSUS TONS/YEAR
CHASSIS



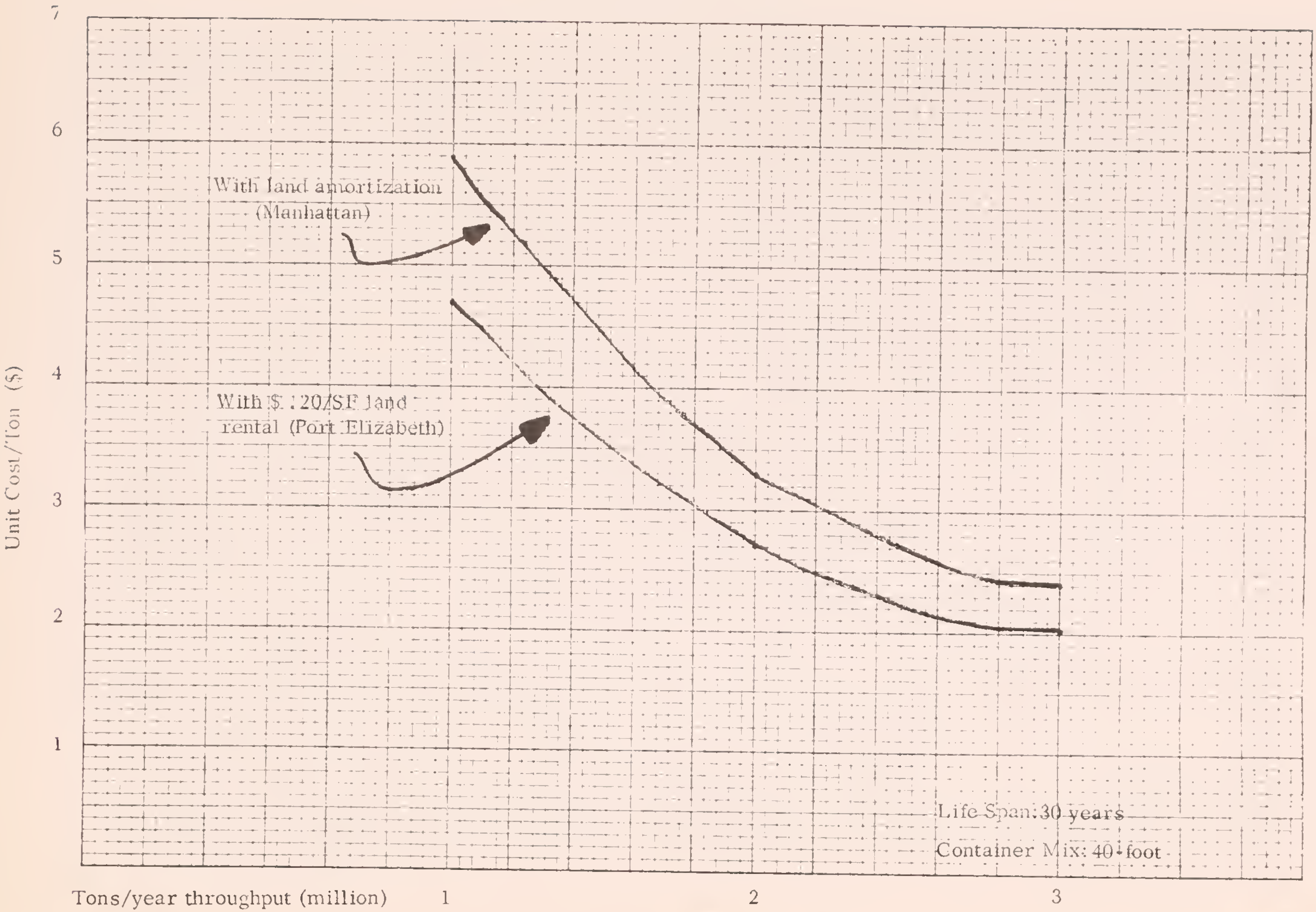
69-a-29

FIGURE 37
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



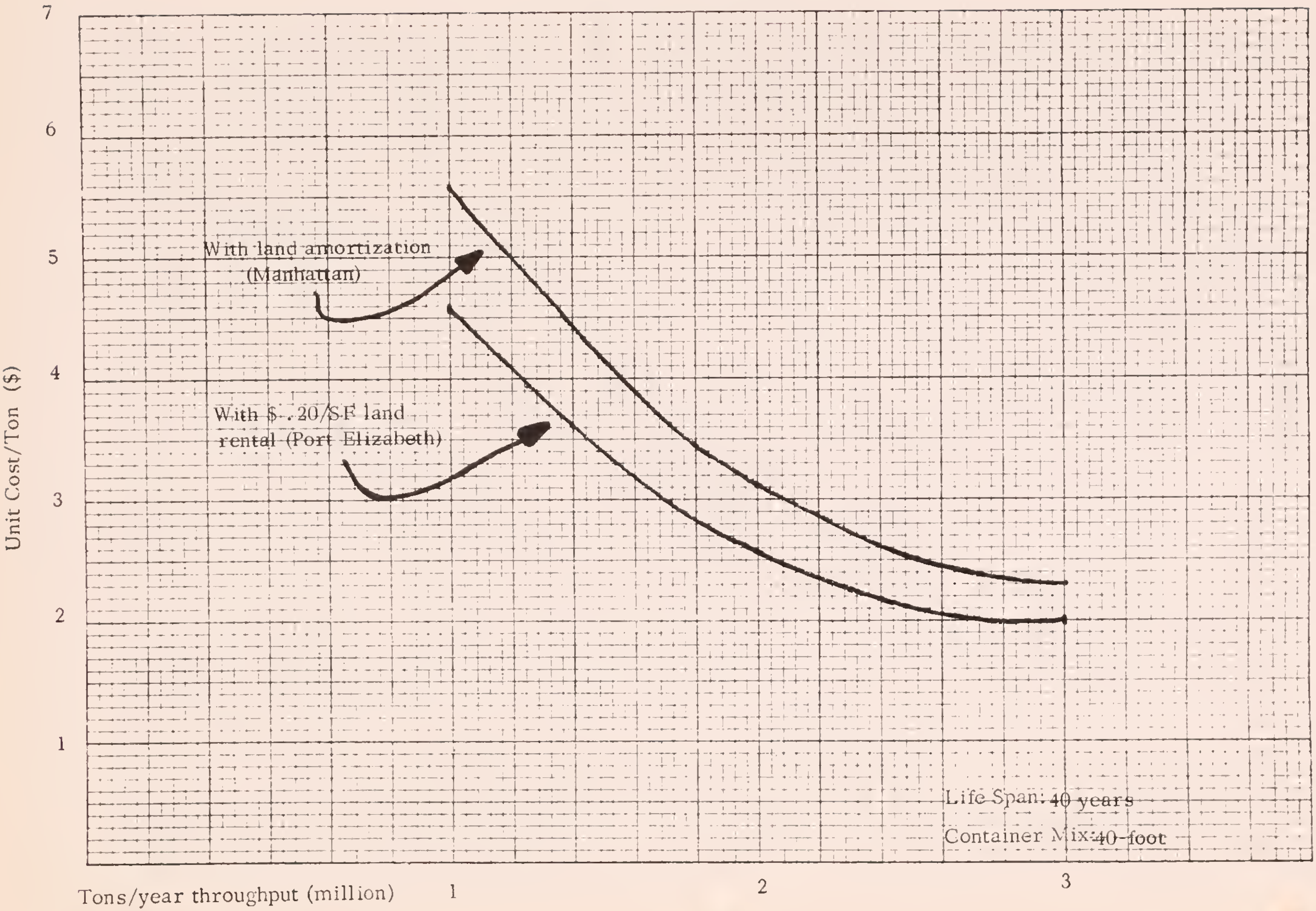
69-a-30

FIGURE 38
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



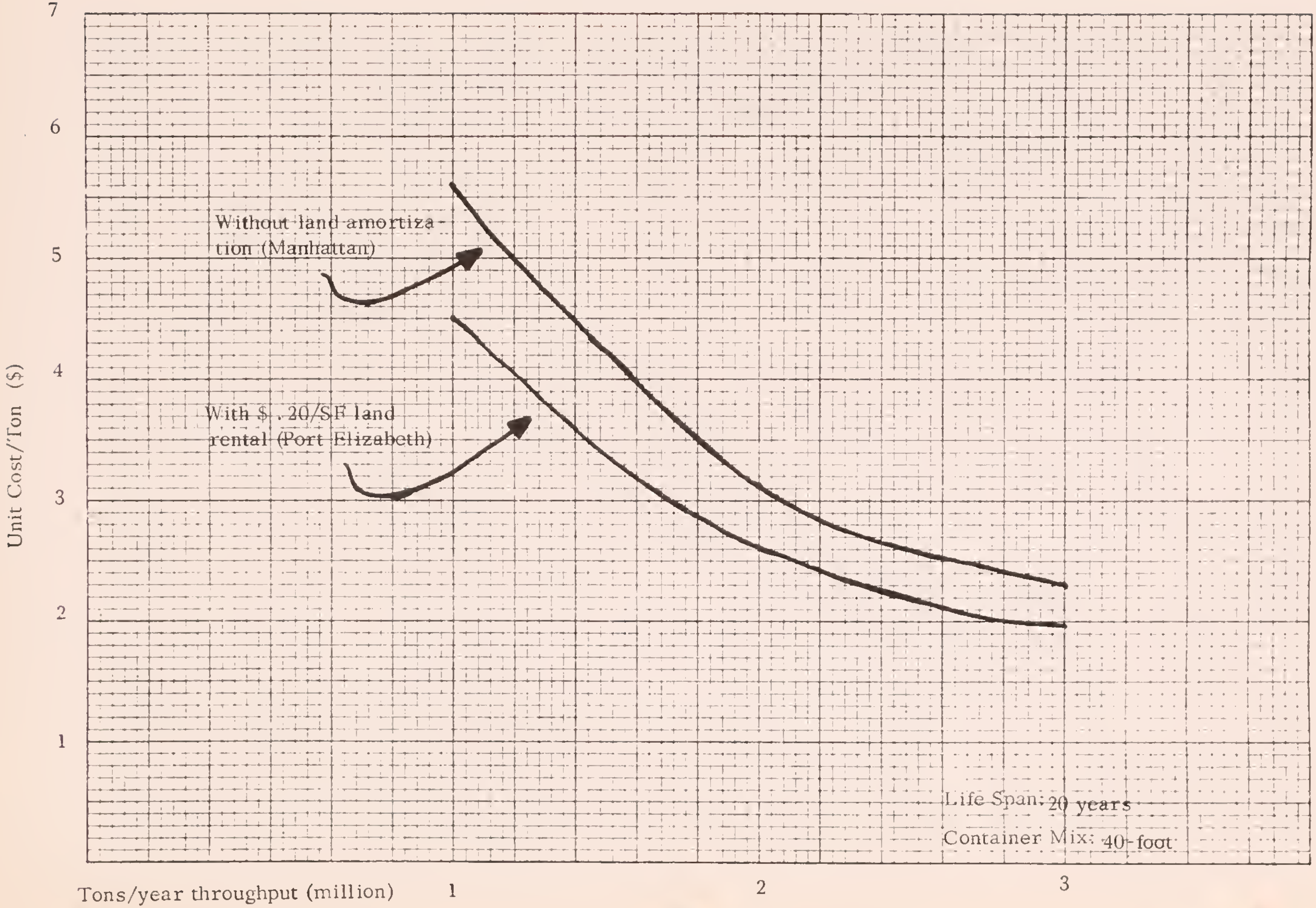
69-a-31

FIGURE 39
UNIT COSTS VERSUS TONS/YEAR
STRADDLE CARRIER



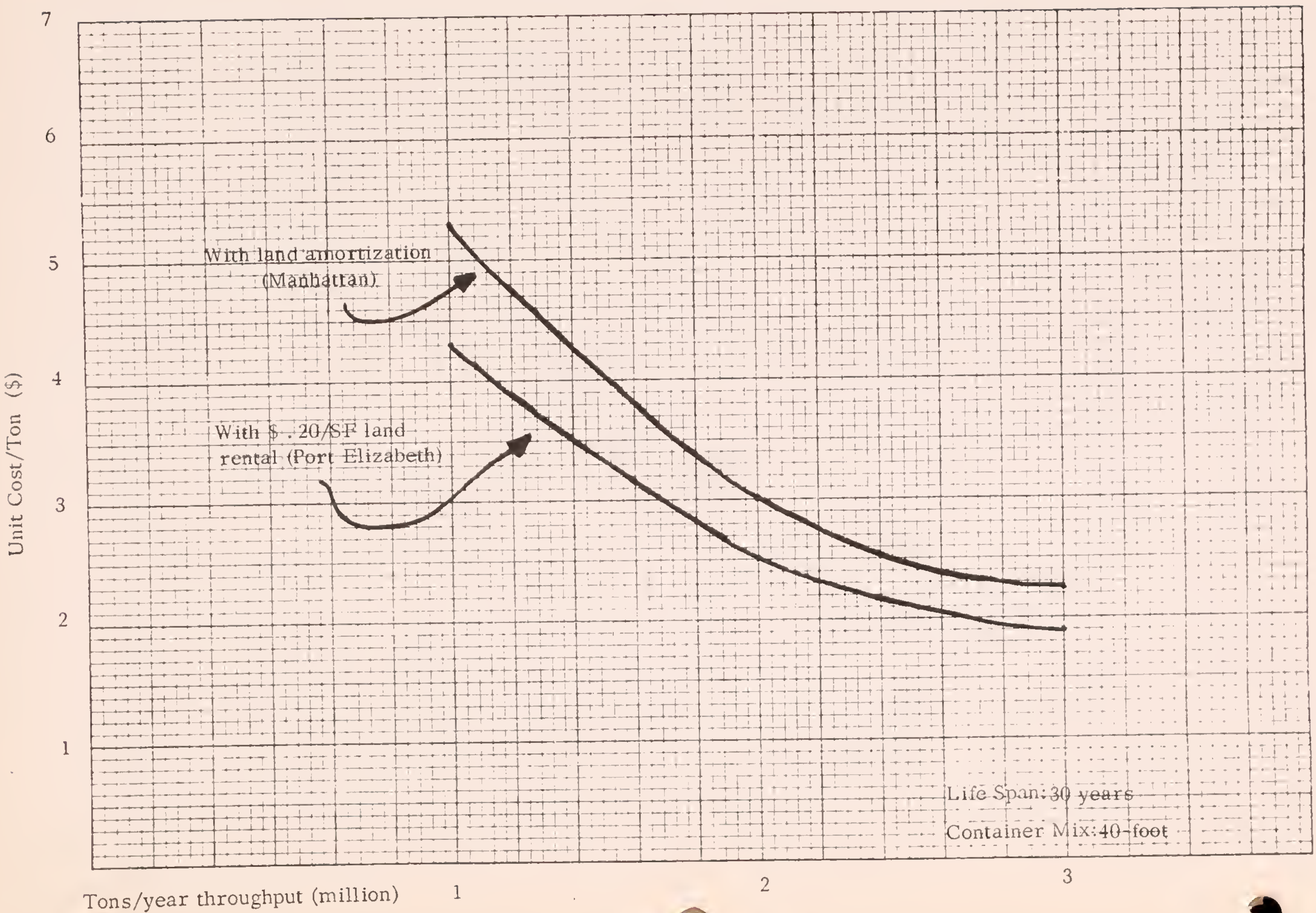
69-a-32

FIGURE 40
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



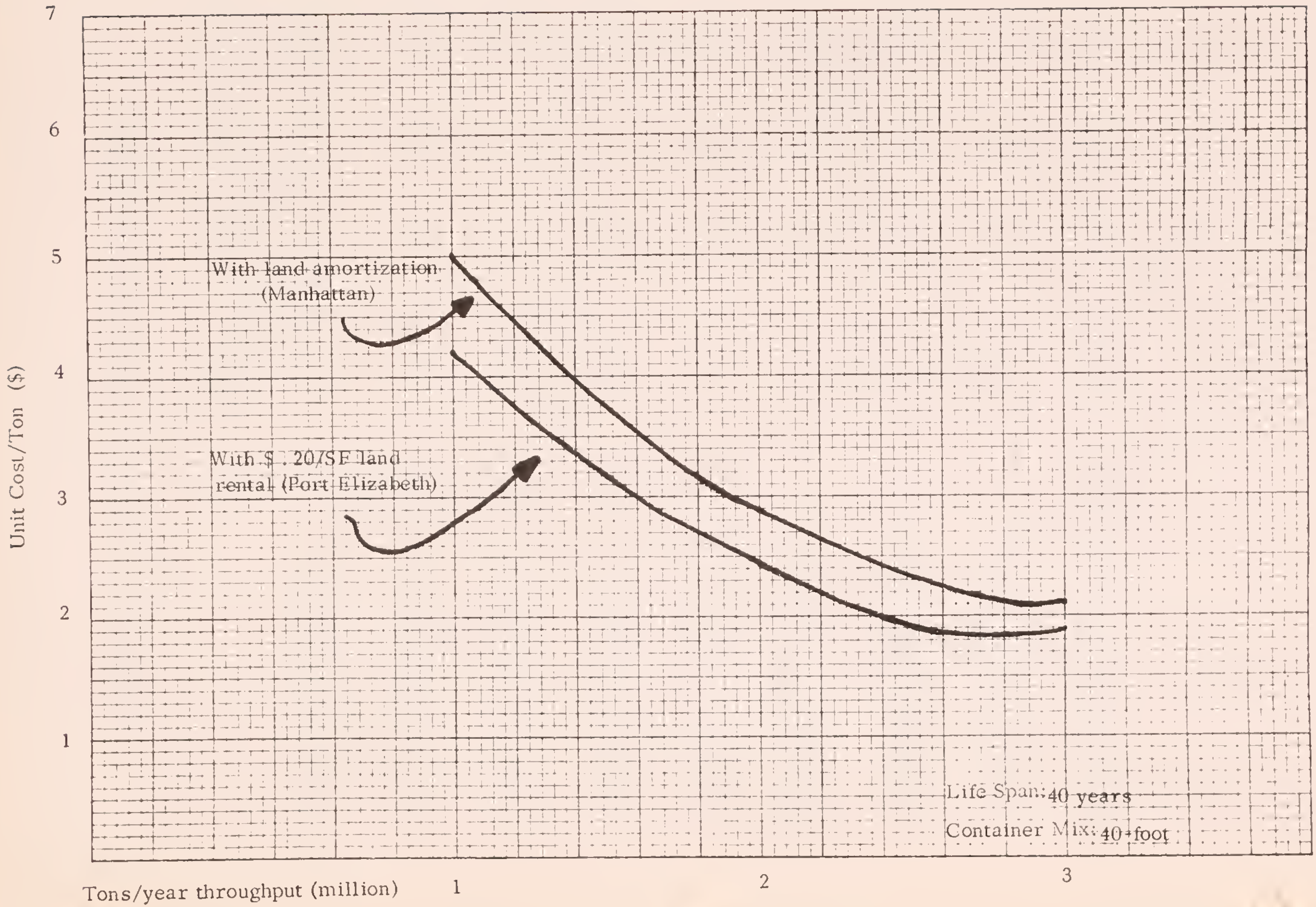
69-a-33

FIGURE 41
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



69-a-34

FIGURE 42
UNIT COSTS VERSUS TONS/YEAR
TRAVEL CRANE



69-a-35

Exhibit 21

COST-PER-TON COMPARISONS FOR 20-FOOT CONTAINER SHIPMENTS

	Vertical Facility	Horizontal Chassis	Horizontal Straddle Carrier	Horizontal Travel Crane
	One-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$6.79	$7.43	$6.86	$6.29
Fixed Rental ($0.20 per sq. ft.)	5.90	5.86	5.60	5.20
30-Year Facility Life				
Amortized Land Fill Costs	$6.26	$7.14	$6.60	$6.05
Fixed Rental ($0.20 per sq. ft.)	5.41	5.66	5.40	5.01
40-Year Facility Life				
Amortized Land Fill Costs	$5.88	$6.79	$6.30	$5.78
Fixed Rental ($0.20 per sq. ft.)	5.16	5.55	5.30	4.91
	Two-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$4.04	$4.34	$4.14	$3.85
Fixed Rental ($0.20 per sq. ft.)	3.60	3.56	3.51	3.31
30-Year Facility Life				
Amortized Land Fill Costs	$3.78	$4.20	$4.01	$3.73
Fixed Rental ($0.20 per sq. ft.)	3.35	3.46	3.41	3.21
40-Year Facility Life				
Amortized Land Fill Costs	$3.59	$4.02	$3.86	$3.59
Fixed Rental ($0.20 per sq. ft.)	3.23	3.41	3.36	3.16
	Three-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$3.13	$3.32	$3.23	$3.04
Fixed Rental ($0.20 per sq. ft.)	2.83	2.79	2.81	2.67
30-Year Facility Life				
Amortized Land Fill Costs	$2.95	$3.22	$3.14	$2.95
Fixed Rental ($0.20 per sq. ft.)	2.67	2.73	2.74	2.61
40-Year Facility Life				
Amortized Land Fill Costs	$2.83	$3.10	$3.04	$2.86
Fixed Rental ($0.20 per sq. ft.)	2.59	2.69	2.71	2.57

Exhibit 22

COST-PER-TON COMPARISONS FOR MIXED[a/] CONTAINER SHIPMENTS

	Vertical Facility	Horizontal: Chassis	Horizontal: Straddle Carrier	Horizontal: Travel Crane
	One-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$6.46	$7.11	$6.50	$5.94
Fixed Rental ($0.20 per sq. ft.)	5.57	5.55	5.25	4.85
30-Year Facility Life				
Amortized Land Fill Costs	$5.94	$6.83	$6.24	$5.69
Fixed Rental ($0.20 per sq. ft.)	5.08	5.34	5.05	4.66
40-Year Facility Life				
Amortized Land Fill Costs	$5.56	$6.47	$5.95	$5.42
Fixed Rental ($0.20 per sq. ft.)	4.84	5.24	4.95	4.56
	Two-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$3.72	$4.03	$3.78	$3.50
Fixed Rental ($0.20 per sq. ft.)	3.27	3.25	3.15	2.95
30-Year Facility Life				
Amortized Land Fill Costs	$3.46	$3.89	$3.65	$3.37
Fixed Rental ($0.20 per sq. ft.)	3.03	3.14	3.06	2.86
40-Year Facility Life				
Amortized Land Fill Costs	$3.27	$3.71	$3.50	$3.24
Fixed Rental ($0.20 per sq. ft.)	2.91	3.09	3.01	2.81
	Three-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$2.80	$3.00	$2.88	$2.68
Fixed Rental ($0.20 per sq. ft.)	2.51	2.48	2.46	2.32
30-Year Facility Life				
Amortized Land Fill Costs	$2.63	$2.91	$2.78	$2.60
Fixed Rental ($0.20 per sq. ft.)	2.34	2.41	2.39	2.26
40-Year Facility Life				
Amortized Land Fill Costs	$2.50	$2.78	$2.69	$2.51
Fixed Rental ($0.20 per sq. ft.)	2.26	2.38	2.36	2.22

[a/] Based on the assumption that 50% will be 20-foot containers and 50%, 40-foot containers.

Exhibit 23

COST-PER-TON COMPARISONS FOR 40-FOOT CONTAINER SHIPMENTS

	Vertical Facility	Horizontal Chassis	Horizontal Straddle Carrier	Horizontal Travel Crane
	One-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$6.14	$6.80	$6.15	$5.59
Fixed Rental ($0.20 per sq. ft.)	5.25	5.23	4.89	4.50
30-Year Facility Life				
Amortized Land Fill Costs	$5.61	$6.51	$5.89	$5.34
Fixed Rental ($0.20 per sq. ft.)	4.76	5.03	4.69	4.30
40-Year Facility Life				
Amortized Land Fill Costs	$5.23	$6.16	$5.59	$5.07
Fixed Rental ($0.20 per sq. ft.)	4.51	4.92	4.59	4.21
	Two-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$3.39	$3.71	$3.43	$3.15
Fixed Rental ($0.20 per sq. ft.)	2.95	2.93	2.80	2.60
30-Year Facility Life				
Amortized Land Fill Costs	$3.13	$3.57	$3.30	$3.02
Fixed Rental ($0.20 per sq. ft.)	2.70	2.83	2.70	2.50
40-Year Facility Life				
Amortized Land Fill Costs	$2.94	$3.39	$3.15	$2.89
Fixed Rental ($0.20 per sq. ft.)	2.58	2.78	2.65	2.46
	Three-Million-Ton Annual Throughput			
20-Year Facility Life				
Unamortized Land Fill Costs	$2.48	$2.69	$2.52	$2.33
Fixed Rental ($0.20 per sq. ft.)	2.18	2.16	2.10	1.97
30-Year Facility Life				
Amortized Land Fill Costs	$2.30	$2.59	$2.44	$2.25
Fixed Rental ($0.20 per sq. ft.)	2.02	2.10	2.04	1.90
40-Year Facility Life				
Amortized Land Fill Costs	$2.18	$2.47	$2.34	$2.16
Fixed Rental ($0.20 per sq. ft.)	1.94	2.06	2.00	1.87

for Manhattan have higher total costs per ton (between 9% and 30%) than similar systems on land with an annual rental of $0.20 per square foot (Port Elizabeth). Thus, the most productive facility is the travel crane system situated on $0.20/sq. ft. rental land (Port Elizabeth).

Chapter IV

ESTIMATED DEMAND FOR A MANHATTAN CONTAINER FACILITY

Introduction

Since existing studies were found inadequate to identify the market for a Manhattan container facility, it was necessary to derive an estimate of demand by the following procedures.

1. Projections of waterborne general cargo tonnage in 1975 for the Port of New York were derived and estimates of Manhattan's share of the PONY tonnage were made.
2. It was assumed that all waterborne general cargo tonnage originating in and destined for Manhattan would represent the major source of demand for a Manhattan container facility and an attempt was made to estimate this tonnage.

In addition, it was necessary to estimate the containerable portion of the tonnage which might be expected to move through Manhattan.

Projections of 1975 Waterborne Trade

Although total waterborne movements include foreign and coastal trade as well as internal waterway and intraport movements, for this analysis only foreign and coastal trade will be considered.[1/] In addition, three commodity groups which move in large quantities (and usually on

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1/ Traffic on internal waterways is excluded since it comprises a very minor portion of PONY waterborne tonnage; and intraport movements are excluded since a container facility would be utilized only for the primary movement of cargo.

special bulk carriers)--coal and coke; petroleum and petroleum products; and sand, gravel and crushed rock--were excluded. Because of the economic advantage of other means of handling these bulk commodities and because their low value/weight and value/density measures indicate that they are not containerable, an adjustment was made to eliminate these bulk cargoes and thus derive a measure of general cargo.

Exhibit 24 presents 1962 data on waterborne movements for the Metropolitan Region[2/] and the Hudson River Channel (the nearest approach to Manhattan statistics available[3/]) as well as estimated general cargo data, while Exhibit 25 presents similar information for 1967.[4/] From these exhibits it appears that general cargo tonnage for the Port of New York has not changed during the five-year period. Thus it seems reasonable to assume that the general cargo trade will remain essentially stable for the near future, giving a 1975 estimate of 23,000,000 short tons for the Port of New York.

A comparison of the general cargo figures for the two years (i.e., before and after the introduction of container terminals in the Port of New York) indicates that, whereas Manhattan accounted for almost

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2/ The "heart of the Port"--according to the Tri-State Transportation Commission's, Waterborne Freight of the Tri-State Region, March 1967--includes 11 major areas. 1) the East River and Brooklyn waterfronts; 2) Newtown Creek; 3) Passaic River; 4) Newark Bay; 5) New York and New Jersey Channels; 6) Raritan River; 7) upper New York Bay; 8) Bay Ridge and Red Hook Channels; 9) Gowanus Creek; 10) Buttermilk Channel; and 11) Hudson River Channel.

3/ Although the Hudson River Channel statistics are overstated to the extent that New Jersey waterborne movements are included, it has been assumed that this overstatement is balanced by the omission of Manhattan's share of the East River tonnages.

4/ Note that Exhibit 25 includes consolidated data for the Port of New York instead of the Metropolitan Region.

Exhibit 24

PORT OF NEW YORK WATERBORNE FREIGHT: 1962
(Short Tons in Thousands)

	All Waterborne Tonnage		Estimated General Cargo Tonnage		
	Metropolitan Region[a]	Hudson River Channel	Metropolitan Region[a]	Hudson River Channel	Hudson River Channel as % of Metropolitan Region
<u>Outbound Movements</u>					
Foreign Exports	7,063	1,861	6,755	1,796	26.6%
Coastal Shipments	13,119	1,238	1,794	324	18.0
Subtotal	20,182	3,099	8,549	2,120	24.8%
<u>Inbound Movements</u>					
Foreign Imports	38,280	2,940	10,311	2,768	26.8%
Coastal Receipts	38,382	1,176	4,100	763	18.6
Subtotal	76,662	4,116	14,411	3,531	24.5%
Total	96,844	7,215	22,960	5,651	24.6%

a/ Includes Hudson River Channel tonnage. See footnote 2 (p.75) for definition of Metropolitan Region.

Source: Tri-State Transportation Commission, <u>Waterborne Freight of the Tri-State Region</u>, Vol. 2, March 1967.

Exhibit 25

PORT OF NEW YORK WATERBORNE FREIGHT: 1967
(Short Tons in Thousands)

	All Waterbrone Tonnage		Estimated General Cargo Tonnage		
	Port of New York	Hudson River Channel	Port of New York	Hudson River Channel	Hudson River Channel as % of PONY
Outbound Movements					
Foreign Exports	6,979	1,576	6,642	1,519	22.9%
Coastal Shipments	19,635	1,481	1,831	284	15.5
Subtotal	26,614	3,057	8,473	1,803	21.3%
Inbound Movements					
Foreign Imports	49,284	2,043	11,505	1,971	17.1%
Coastal Receipts	29,464	670	3,801	192	5.1
Subtotal	78,748	2,713	15,306	2,163	14.1%
Total	105,362	5,770	23,779	3,966	16.7%

Source: Department of the Army, Corps of Engineer, Waterborne Commerce of the United States, Part 1, 1967.

25% of PONY tonnage in 1962, it represented less than 17% of PONY general cargo trade in 1967. Since it can be argued that the poorer competitive position of Manhattan in the general cargo trade is due to a lack of a container terminal, it may be appropriate to estimate Manhattan's potential share of the market in 1975--i.e., assuming the existence of an MCF--on the basis of the 1962 performance rather than that of 1967. Thus, a maximum demand figure of 5,650,000 short tons of general cargo can be projected for Manhattan. However, in view of the overall trends in the several segments of waterborne commerce, it was necessary to adjust the 1962 figures, and the 1975 projections used in the subsequent analysis are based on the following:

	Short Tons (in thous.)
Outbound Movements	
Foreign Exports	1,700
Coastal Shipments	320
Subtotal	2,020
Inbound Movements	
Foreign Imports	2,980
Coastal Receipts	650
Subtotal	3,630
Total	5,650

Manhattan Origin/Destination Tonnage

However, since it seems unlikely that Manhattan can regain the share of the tonnage lost to the other segments of PONY with existing container facilities, it would appear necessary to take the approach that all the waterborne general cargo tonnage originating in and destined for

Manhattan would represent the major souce of demand for a Manhattan container facility.

According to Bureau of the Census data, of the 1956 waterborne foreign trade outbound and inbound through the Port of New York, 44% of the exports originated in the Metropolitan Region and 72% of the imports were destined for the Metropolitan Region. Inasmuch as more recent information is not available, it was necessary to assume that these percentages pertain currently and will continue to be valid for 1975. If one further assumes that these percentages are valid for Manhattan, the estimates of general cargo foreign trade tonnages originating in and destined for Manhattan are derived.

	Short Tons (in thous.)
Outbound Movements	
Foreign Exports	750
Coastal Shipments[5/]	320
Subtotal	1,070
Inbound Movements	
Foreign Imports	2,150
Coastal Receipts[5/]	650
Subtotal	2,800
Total	3,870

Thus, a minimum demand figure of general cargo tonnage for Manhattan appears to be 3,870,000 short tons.

[5/] At this point, it has been assumed that all coastal trade docking in Manhattan originates in or is destined for Manhattan.

However, since it is extremely unlikely that a Manhattan container facility would handle only tonnage originating in or destined for Manhattan, it is necessary to make an estimate of the general cargo with origins/destinations elsewhere in the Metropolitan Region which might use a MCF. This was arrived at through an analysis of truck and rail movements for Manhattan vs. the Region. From Exhibit 26, it can be seen that almost 12% of truck and rail movements in and out of the Metropolitan Region is bound for or originates in Manhattan.

Exhibit 26

TRUCK AND RAIL MOVEMENTS FOR
PORT OF NEW YORK AND MANHATTAN
(Short Tons in Thousands)

	PONY Region	Manhattan	Manhattan as % of Region
Rail Movements[a/]	30,489	3,231	10.6%
Truck Movements	18,810	2,605	13.8
Total	49,299	5,836	11.8%

[a/] Other than coal and perishable foods.

Source: Derived from Metropolitan Transportation--1980, op. cit.

Therefore, it seems feasible to increase the minimum demand figures above by 12%, giving the following estimates for the 1975 Manhattan general cargo market.

	Short Tons (in thous.)
Outbound Movements	
Foreign Exports	840
Coastal Shipments	360
Subtotal	1,200
Inbound Movements	
Foreign Imports	2,410
Coastal Receipts	730
Subtotal	3,140
Total	4,340

Containerable Trade

Since not all general cargo is adaptable to containerization, the next step is to estimate the containerable portion of the general cargo tonnage moving through Manhattan

Criteria for Identifying Noncontainerable Commodities

There are two basic criteria for identifying noncontainerable commodities.

1. Inappropriate size--commodities that would not fit into a standard 8' x 8' x 20' or 8' x 8' x 40' container.

2. Bulk cargo--commodities moving in such large quantities that special carriers and loading methods have been developed which are economically superior to containerized transport. In applying these criteria to Bureau of the Census data, it should be noted that a commodity group is actually a collection of related product identities, and thus some of the products in the commodity group may be containerable while others are not.

While the Port of New York Authority calculates that 75% of PONY general cargo is containerable, this figure will not be attained for some time. The analysis conducted by the Authority gives a PONY figure of 50% for 1975, and it has been assumed that this percentage will be applicable to Manhattan, resulting in a market of 2,170,000 short tons (or 1,940,000 long tons) of containerable general cargo for a Manhattan container facility in 1975.

Estimated Actual Demand for A Manhattan Container Facility

The objective of this section is to identify the market and demand factors which would influence potential users of an MCF. The analysis is structured to include the following topics:

- The characteristics of container companies and existing/under construction container facilities in the Port of New York.
- Competition from air cargo.
- Incremental costs and a single large container facility.

The Port of New York has approximately 20 million long tons of annual container berth capacity in operation or under construction. An additional 5 million long tons of capacity is in the planning stage. (See Exhibit 27.) The estimates of containerized cargo flowing through the Port of New York by 1975 range from 8.8 million to 12.75 million long tons.[6/] Thus, existing or planned container berth capacity in the Port of New York is double the 1975 projection of possible container cargo traffic.

[6/] The various projections are discussed in Vincent A. G. O'Connor, The Port of New York in Transition: Breakbulk to Container, 1968, p. 49.

Exhibit 27

PORT OF NEW YORK CONTAINER TERMINAL CAPACITY: 1969

	No. of Berths	Annual Capacity (long tons in millions)
Terminals in Operation		
Port Elizabeth	10	6.0
Edgewater	1	0.6
Subtotal	11	6.6
Terminals Under Construction		
Port Elizabeth	16	9.6
Howland Hook	4	2.4
Stapleton	2	1.2
Subtotal	22	13.2
Planned		
Port Elizabeth	3	1.8
Stapleton	1	0.6
Seatrain-West New York	3	1.8
Northeast Marine-Brooklyn	2	1.2
Subtotal	9	5.4
Total	42	25.2

Source: Docket No. 69-56, Federal Maritime Commission, Agreement No. 9827 Between United States Lines, Inc. and Sea-Land Service, Inc., Volume II, Appendix II, p. 89. Northeast Marine was added to the basic source material.

The Structure of Container Shipping Companies

Container shipping companies in the Port of New York are dominated by Sea-Land Service, Inc. If the proposed leasing of 16 U.S. Lines containerships to Sea-Land occurs, one company would operate 66% of all U.S.-flag containerships in U.S. foreign commerce and 78% of the total annual U.S.-flag container capacity in the North Atlantic by 1972. Since Sea-Land is committed on a long-term basis to Port Elizabeth, their dominant role in the industry would make it extremely difficult to attract container cargo to the proposed MCF. In addition, the other U.S.-flag operators are generally committed to existing or planned terminals in Staten Island or New Jersey as are some of the foreign-flag companies engaged in the container trade.

There are several container or "near-container" companies serving the Port of New York who have short-term commitments to use their present container location or who have not committed themselves to a facility pending delivery of containerships (or LASH) under construction. Prominent among this group is the Belgian Line and Hapag-Lloyd, reported to be "unhappy customers of International Terminal operators"[7/] at Port Elizabeth,[8/] the Japanese lines who are awaiting delivery of containerships,[9/] and Prudential Lines whose LASH type vessels are to be delivered in 1971. It appears that LASH type vessels would not require a container

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7/ Equity Research Associates, Containerization, May 16, 1969, p. 3.

8/ In 1972, Belgian Line and Hapag-Lloyd will have in service 2.5 million long tons of container capacity representing 7 ships with an average of two sailings per week. An 80% utilization is necessary to reach a 2-million-ton throughput.

9/ Probably will use the Northeast Marine Terminal in Brooklyn.

facility but could utilize existing piers. LASH vessels could carry more than 1 million long tons of containerable cargo, thus diminishing further the tonnage available to an MCF.

In summary, the present structure of the container industry and the future outlook is not a promising environment for the MCF. However, some possibility does exist--albeit of low probability--that an operator may be available, given economic incentives.

Air Cargo Competition

Air cargo projections for 1972 and beyond indicate that substantial portions of prime containerable tonnage of high-value low-bulk commodities will be shipped by air. By the end of 1968, 1.1 million tons of air cargo moved through the Greater New York Airports. It is forecast by the FAA that 3 million tons will be carried by the end of 1972.[10/] The John F. Kennedy International Airport carries 75% of the air cargo and 55% originates or is destined for Manhattan.[11/] Although much of the air cargo is domestic, a substantial amount is international and would be competitive with ocean container shipping.

Incremental Costs

Under most containerport arrangements, costs per ton are lower at higher throughputs.[12/] Therefore, the incremental costs (e.g., for the third million ton of cargo) are substantially lower than for the first or even second million tons at a new container facility. The

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10/ Quoted in: Parsons, Brinckerhoff, Quade & Douglas, Inc., Proposed Combined STOL/Air Cargo Terminal, January 1969, p. 4.

11/ Ibid., p. 5.

12/ Except user charges, unless a volume discount scale is used.

implications of these economies of scale are such that as long as throughput capacity is available at the operators' present locations, economic penalties would be incurred by shifting to an MCF. This is a further limiting factor on the availability of container cargo to an MCF.

Thus, the structure of the container shipping industry, air cargo competition, and the economics of container terminal operations place severe limits on the ability of an MCF to generate 2 million tons of container cargo.

CHAPTER V

COSTS AND BENEFITS

Introduction

The objective of this chapter is to define and measure the costs and benefits which would accrue to the City Government of New York of the proposed Manhattan Container Facility. Two types of costs were quantified.

- Fixed and operating expenses of the MCF less user fees.
- Capital costs of street improvements necessary to serve the MCF.

The above costs were then compared to the following benefits (tax revenues) accruing to the City from the MCF.

- Personal income tax (residents and nonresidents).
- General corporation tax (trucking).
- Gross earnings tax.
- New York City sales tax.

Non-quantifiable costs--such as increases in traffic congestion and environmental pollution as a result of the MCF--were not considered in the benefit/cost analysis. In addition, the benefits and costs of alternative site uses were not included.[1/]

1/ The capital costs (excluding land) of a proposed MCF total $24 million. Manufacturing industries in the U. S. which are considered to have very high investment per employee average $30,000 per employee (source: derived from Growth and Labor Characteristics of Manufacturing Industries, U. S. Dept. of Commerce). The proposed MCF would have an

The following analysis is based on a comparison of the annual costs and benefits of an MCF with the following characteristics:

- Three million tons per year throughput
- Twenty-year life
- Horizontal travel crane system
- Manhattan site without land amortization
- Port Elizabeth site with $.20 per square foot land rental
- 50% 20-foot containers, 50% 40-foot containers

The analysis could be performed varying the volumes, mixes, systems and other factors and would produce a similar relation between cost/benefits.

Costs

The fixed and operating costs of moving a ton of container cargo through an MCF are $.36 higher than moving the same ton through the Port Elizabeth container terminal.[2/] Annual fixed costs for an MCF would amount to $4,885,000 compared to $3,796,000 in Port Elizabeth. The $1,089,000 may be considered to be operating deficit of the MCF, and is one item of quantifiable costs to the City of New York.[3/]

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investment per employee in excess of $75,000. Clearly, the location of virtually any type of manufacturing facility on the site would generate greater employment than an MCF.

2/ See Exhibit 22, p. 71 for supporting data.

3/ Fire and police protection costs are another category of additional costs to the City for an MCF. Although there is currently excess fire protection capacity in the lower Manhattan area, the construction of an MCF would require that a company of firemen who would otherwise be laid off (or transferred) would be retained. The cost the NYC to maintain one company of firemen is $500,000 annually. (Jan Chaiken, Rand Corporation, New York City Project Office, Urban Studies Office.) The design of the port area would permit only one

The second major category of increased costs relates to the increased amount of trucks and other vehicular traffic serving the MCF. This would necessitate some improvements in street widening in the immediate area. Exhibit 29 presents data on the average number of trucks passing through the MCF gates per week. A three-million ton throughput with a mix of 50% 20-foot and 50% 40-foot containers would generate 9,562 truck movements per week. Under peak loading conditions, it is possible that 50 percent of the truck movements would occur in a single day,[4/] or, roughly 4,780 truck movements. Translating the number of peak truck movements into requirements for wider streets <u>only</u> in the immediate area of the MCF is extremely difficult. Origins and destinations, other local traffic, city wide traffic flows and levels, seasonal factors, and existing street widths are some of the variables which affect the requirements for additional street capacity. Our analysis does indicate that the MCF would generate at peak periods approximately 15 percent more truck traffic than presently exists in the square mile surrounding the MCF.[5/]

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protection post at the gate. Continuous protection of one post requires five policemen at an average annual cost to the City of New York of $13,200 each, or a total of $66,000. (Ed Blum, Rand Corporation, New York City Project Office, Urban Studies Office.)

4/ See Chapter II, p.6, for supporting analysis.

5/ Developed from data contained in Tri-State Transportation Commission, "Streets and Highways: A Regional Report," January 1968.

EXHIBIT 29

AVERAGE NUMBER OF TRUCKS PASSING THROUGH THE MCF GATES PER WEEK

I. If all full truck loads (FTL) are 20-ft. containers

Annual Throughput	LTL Traffic (per week)	FTL (per week)	Total (per week)
3 million tons	6,750	3,750	10,500
2 million tons	4,500	2,500	7,000
II. If all full truck loads (FTL) are 40-ft. containers			
3 million tons	6,750	1,875	8,625
2 million tons	4,500	1,250	5,750
III. If full truck loads (FTL) are 50%-20' and 50%-40' containers			
3 million tons	6,750	2,812	9,562
2 million tons	4,500	1,875	6,375

Note: Computation of Truck Movements at the Manhattan Container Facility

An annual throughput of 3 million tons per year assumes an average of 3,000 20-ft. equivalents in and out per week, assuming ten long tons per 20-ft. equivalent (with an imbalance in trade, more containers would be necessary). Assuming that 50% of the 20-ft. equivalents outbound are stuffed and 25% of thos inbound are stripped gives a total of 2,250 20-ft. equivalents per week which travel outside the terminal by means of smaller trucks. Assuming three smaller trucks for the gates of the container facility each week. (This assumes that a smaller truck which leaves off cargo at the terminal does not pick up cargo.) The full container loads will total 3,750 20-ft. equivalents per week. If all full container loads travel in 20-ft. containers, the total number of trucks passing through the gate weekly will be 10,500. (This assumes that a tractor bringing in a 20-ft. container does not carry a container out.) If all the full container load cargo traveled in 40-ft. containers, the total number of trucks per week would be reduced to 8,625.

This does not mean that the entire street capacity in the area must be increased by 15 percent, but it does indicate that for some of the major arteries in the area widening would be necessary to handle the truck traffic flow out of the area. Accordingly, we have estimated that there are three miles of street to be widened by the addition of two twelve-foot lanes. The capital costs of the improvements consists of construction costs and land acquisition costs.[6/]

Total construction costs were estimated as follows:

> 15,840 feet (3 miles) x 24 feet (2 lanes) = 380,160 square feet x $1.50 per square foot construction costs[7/] = $570,000 total construction costs.

Land acquisition costs were calculated by using $40 per square foot as the basis to compute an estimated total land cost of $15,200,000.

Thus, the total costs for necessary street improvements would amount to $15,770,000. The average annual cost (excluding amortization, maintenance and repair) would amount to $1,104,000.[8/] The impact on streets and highways outside the immediate area of the MCF was not included as a cost.

In summary, the total annual costs to the City of New York which would result from the operation of the proposed MCF are:

6/ Although it is not realistic, as a practical matter we have not included costs of buildings and fixtures, demolition and relocation in street improvement costs.

7/ Department of Public Works, City of Boston, Massachusetts

8/ $15,770,000 at 7% per year.

•	Net operating deficit	$ 1,089,000
•	Street improvements	1,104,000
	Total annual costs	$ 2,193,000

Over the twenty-year life of the MCF total costs would be in excess of $ 43 million.

Benefits

The income generated directly and indirectly by employment related to the MCF is responsible for producing benefits to the City Government of New York in the form of additional tax revenues. The following assumptions were made in the computation of benefits.

- All employment from the MCF represents a new employment gain. No employment shifts from other jobs are assumed.
- All container traffic for the MCF is a total gain in cargo for New York City trade.
- Employment in the following supporting services in New York City will <u>not</u> increase as a result of the container-port because these services are provided almost entirely by New York firms for the entire Port of New York district: banking, insurance, cargo inspection, testing and weighing, cargo survey, cooping, dredging, freight forwarding and customs brokers, import/export services, launch services, marine equipment and supply, marine engineering, ocean transportation, oil bunkers, radio and telephone, rigging, security, towing and barging, customs agents and quarantine officers (Federal employees), ship repair and shipbuilding, and export packers.

- The trucking industry would be the prime direct beneficiary of the MCF.

Total direct employment at the MCF would amount to a maximum of 300 employees and $3,000,000 in annual wages and salaries.9/ It was estimated that 10 percent of the employees would live outside New York City10/ and two-thirds of the disposable income (DI) of the remaining employees would be spent for consumption within New York City. The expenditures within the city would generate additional income and expenditures--the multiplier effect--roughly 2.5 times11/ the original expenditure. The computation was developed as follows:

A.	Total direct wages and salaries	$ 3,000,000
B.	Less out of city residents at 10%	300,000
C.	Total Disposable Income (75% of total)	2,025,000
D.	Consumption in NYC (2/3 of DI)	1,350,000
E.	Total direct and indirect income generated ($1,350,000 x 2.5 multiplier)	3,375,000
F.	Additional sales tax revenue to the City (3% of 20% of NYC consumption income generated, $3,375,00012/)	20,000

The direct employment at the MCF and the additional income/employment generation produces a net increase in sales tax revenue to the City of New York of $20,000.

9/ Derived from Chapter III.

10/ Estimated by ILA consultant.

11/ We have used the multiplier developed in "The Economic Impact of the Port of Baltimore on Maryland," Stanley Hille and James Suelflow, University of Maryland, June 1969.

12/ Internal Revenue Service computations for New York show that a $10,000 gross income employee with four deductions pays a three percent sales tax (city portion only) on approximately 20 percent of his disposable income.

Increased employment is also created for the trucking industry. There were estimated to be 9,562 truck movements per week generated by the MCF, or 478,125 truck movements per year. Assuming each truck trip consumes six man-hours of labor (one driver and one-half helper at four hours each) 13/ at a labor cost of approximately $4 per hour, 14/ or $24 a total trip wage, $11,475,000 in additional income would accrue to truckers each year. Applying the same methodology used for the direct employees of the MCF, additional sales tax revenues would amount to $78,000.

Other sources of tax gain to the City of New York were estimated to be:

• Personal income tax, residents	$ 90,000
• Personal income tax, nonresidents	15,000
• General corporation tax, trucking	112,500
• Gross earnings tax, transportation companies	112,500

Therefore, the total tax revenue increase which would be received annually by the City of New York as a result of the MCF amounts to $428,000.

Conclusion

The costs to the City of New York of building and operating the proposed MCF exceed the revenues received by the City by $1,765,000 per year, or a ratio of costs to benefits of more than four to one. This amounts to about $35 million over the estimated twenty-year life of the proposed facility.

13/ A reasonable assumption considering the expected Manhattan origin/destination of most cargo at the MCF.

14/ Based on union wage scales for general freight trucks, July 1968, U.S. Department of Labor, Vureau of Labor Statistics, New York Office.

CHAPTER VI

CONCLUSIONS

We have concluded that it is not economically feasible to locate a container facility on Manhattan.

- The costs to the City of New York exceeds the revenues gained by $1.8 million per year, or $35 million over the life of the facility.
- By 1972, container berth capacity (supply), currently in operation or under construction, in the Port of New York will exceed the available container cargo traffic (demand) by at least a 2 to 1 ratio.
- Containerable cargo with origins/destinations in Manhattan just about equals the minimum amount of throughput required for an MCF. Long term economic and competitive trends in Manhattan point to a continued decline in containerable cargo generated in Manhattan.
- The structure and economics of the international container shipping industry make it highly improbable that a user(s) could be attracted to an MCF.